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June 1993

EUROPEAN AEROSPACE SCIENCE AND TECHNOLOGY 1992

A BIBLIOGRAPHY WITH INDEXES



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EUROPEAN AEROSPACE SCIENCE AND TECHNOLOGY 1992

A BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration
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800 Elkridge Landing Road, Linthicum Heights, MD 21090-2934, (301) 621-0390.

INTRODUCTION

The technical literature covered in this bibliography describes selected research and development performed by 22 European countries, including the NATO countries. The purpose of this bibliography is to assist NASA R&D efforts and thus increase productivity of the NASA community. The references were compiled from the NASA Scientific and Technical Information Database in part by using the *Aeronautical Engineering, NASA SP-7037* profile to select items. The coverage was limited to items accessioned in 1992. An earlier bibliography, *Current European Aeronautics, 1983-1985*, included items accessioned from January 1983 through June 1985. For current aeronautical engineering worldwide coverage refer to the monthly *Aeronautical Engineering Bibliography, NASA SP-7037*, or search the NASA RECON online bibliographic database.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR/IAA* subject categories. A subject index further identifies subject areas of specific interest. In addition to the subject index, this bibliography provides an author index, a corporate source index, a contract number index, a foreign technology index, a report number index, and an accession number index. Each index entry includes the accession number and the page number to assist the user in locating the full citation in the abstract section.

Other foreign technology bibliographies of possible interest include:

- Soviet Aeronautics, NASA SP-7052 (1984)*
- Soviet Aeronautics and Astronautics, NASA SP-7059 (1985)*
- Soviet Aeronautics and Astronautics 1986, NASA SP-7062*
- Soviet Science and Technology 1987, NASA SP-7066*
- Soviet Aerospace Science and Technology 1988, NASA SP-7077*
- Soviet Aerospace Science and Technology 1989, NASA SP-7083*
- Soviet Aerospace Science and Technology 1990, NASA SP-7095*
- Commonwealth of Independent States (CIS) Aerospace Science and Technology 1991, NASA SP-7101*
- Commonwealth of Independent States (CIS) Aerospace Science and Technology 1992, NASA SP-7106*
- Japanese Science and Technology, 1983-1984, NASA SP-7054*
- Japanese Science and Technology, NASA SP-7057 (1985)*
- Japanese Science and Technology 1986, NASA SP-7060*
- Japanese Science and Technology 1987, NASA SP-7067*
- Japanese Aerospace Science and Technology 1988, NASA SP-7075*
- Japanese Aerospace Science and Technology 1989, NASA SP-7081*
- Japanese Aerospace Science and Technology 1990, NASA SP-7093*
- Japanese Aerospace Science and Technology 1991, NASA SP-7100*
- Japanese Aerospace Science and Technology 1992, NASA SP-7104*

TABLE OF CONTENTS

AERONAUTICS For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL)	1
02 AERODYNAMICS	6
Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also <i>34 Fluid Mechanics and Heat Transfer</i> .	
03 AIR TRANSPORTATION AND SAFETY	53
Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also <i>16 Space Transportation</i> and <i>85 Urban Technology and Transportation</i> .	
04 AIRCRAFT COMMUNICATIONS AND NAVIGATION	58
Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also <i>17 Space Communications, Spacecraft Communications, Command and Tracking</i> and <i>32 Communications and Radar</i> .	
05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE	67
Includes aircraft simulation technology. For related information see also <i>18 Spacecraft Design, Testing and Performance</i> and <i>39 Structural Mechanics</i> . For land transportation vehicles see <i>85 Urban Technology and Transportation</i> .	
06 AIRCRAFT INSTRUMENTATION	88
Includes cockpit and cabin display devices; and flight instruments. For related information see also <i>19 Spacecraft Instrumentation</i> and <i>35 Instrumentation and Photography</i> .	
07 AIRCRAFT PROPULSION AND POWER	93
Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also <i>20 Spacecraft Propulsion and Power</i> , <i>28 Propellants and Fuels</i> , and <i>44 Energy Production and Conversion</i> .	
08 AIRCRAFT STABILITY AND CONTROL	103
Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also <i>05 Aircraft Design, Testing and Performance</i> .	
09 RESEARCH AND SUPPORT FACILITIES (AIR)	110
Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also <i>14 Ground Support Systems and Facilities (Space)</i> .	

ASTRONAUTICS For related information see also *Aeronautics*.

12 ASTRONAUTICS (GENERAL)	118
For extraterrestrial exploration see <i>91 Lunar and Planetary Exploration</i> .	
13 ASTRODYNAMICS	122
Includes powered and free-flight trajectories; and orbital and launching dynamics.	
14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)	125
Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. For related information see also <i>09 Research and Support Facilities (Air)</i> .	
15 LAUNCH VEHICLES AND SPACE VEHICLES	126
Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also <i>20 Spacecraft Propulsion and Power</i> .	
16 SPACE TRANSPORTATION	128
Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also <i>03 Air Transportation and Safety</i> and <i>18 Spacecraft Design, Testing and Performance</i> . For space suits see <i>54 Man/System Technology and Life Support</i> .	
17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING .	129
Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also <i>04 Aircraft Communications and Navigation</i> and <i>32 Communications and Radar</i> .	

N.A.—no abstracts were assigned to this category for this issue.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 130
Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance*, *39 Structural Mechanics*, and *16 Space Transportation*.

19 SPACECRAFT INSTRUMENTATION 139
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

20 SPACECRAFT PROPULSION AND POWER 140
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *44 Energy Production and Conversion*, and *15 Launch Vehicles and Space Vehicles*.

CHEMISTRY AND MATERIALS

23 CHEMISTRY AND MATERIALS (GENERAL) 143

24 COMPOSITE MATERIALS 143
Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials*.

25 INORGANIC AND PHYSICAL CHEMISTRY 147
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics*.

26 METALLIC MATERIALS 148
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 150
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

28 PROPELLANTS AND FUELS 151
Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

29 MATERIALS PROCESSING 151
Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology*.

ENGINEERING For related information see also *Physics*.

31 ENGINEERING (GENERAL) 152
Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 155
Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking*. For search and rescue see *03 Air Transportation and Safety*, and *16 Space Transportation*.

33 ELECTRONICS AND ELECTRICAL ENGINEERING 159
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

34 FLUID MECHANICS AND HEAT TRANSFER 161
Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

35 INSTRUMENTATION AND PHOTOGRAPHY 206
Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

36 LASERS AND MASERS 210
Includes parametric amplifiers. For related information see also *76 Solid-State Physics*.

37 MECHANICAL ENGINEERING	211
Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.	
38 QUALITY ASSURANCE AND RELIABILITY	214
Includes product sampling procedures and techniques; and quality control.	
39 STRUCTURAL MECHANICS	217
Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see <i>05 Aircraft Design, Testing and Performance</i> and <i>18 Spacecraft Design, Testing and Performance</i> .	
GEOSCIENCES For related information see also <i>Space Sciences</i> .	
42 GEOSCIENCES (GENERAL)	N.A.
43 EARTH RESOURCES AND REMOTE SENSING	221
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see <i>35 Instrumentation and Photography</i> .	
44 ENERGY PRODUCTION AND CONVERSION	226
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also <i>07 Aircraft Propulsion and Power</i> , <i>20 Spacecraft Propulsion and Power</i> , and <i>28 Propellants and Fuels</i> .	
45 ENVIRONMENT POLLUTION	226
Includes atmospheric, noise, thermal, and water pollution.	
46 GEOPHYSICS	230
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see <i>93 Space Radiation</i> .	
47 METEOROLOGY AND CLIMATOLOGY	234
Includes weather forecasting and modification.	
48 OCEANOGRAPHY	241
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also <i>43 Earth Resources and Remote Sensing</i> .	
LIFE SCIENCES	
51 LIFE SCIENCES (GENERAL)	244
52 AEROSPACE MEDICINE	245
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.	
53 BEHAVIORAL SCIENCES	249
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.	
54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT	251
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also <i>16 Space Transportation</i> .	
55 SPACE BIOLOGY	254
Includes exobiology; planetary biology; and extraterrestrial life.	
MATHEMATICAL AND COMPUTER SCIENCES	
59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)	N.A.
60 COMPUTER OPERATIONS AND HARDWARE	255
Includes hardware for computer graphics, firmware, and data processing. For components see <i>33 Electronics and Electrical Engineering</i> .	
61 COMPUTER PROGRAMMING AND SOFTWARE	255
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.	
62 COMPUTER SYSTEMS	260
Includes computer networks and special application computer systems.	

63 CYBERNETICS	260
Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also <i>54 Man/System Technology and Life Support</i> .	
64 NUMERICAL ANALYSIS	261
Includes iteration, difference equations, and numerical approximation.	
65 STATISTICS AND PROBABILITY	N.A.
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.	
66 SYSTEMS ANALYSIS	264
Includes mathematical modeling; network analysis; and operations research.	
67 THEORETICAL MATHEMATICS	265
Includes topology and number theory.	
PHYSICS For related information see also <i>Engineering</i> .	
70 PHYSICS (GENERAL)	265
For precision time and time interval (PTTI) see <i>35 Instrumentation and Photography</i> ; for geophysics, astrophysics or solar physics see <i>46 Geophysics</i> , <i>90 Astrophysics</i> , or <i>92 Solar Physics</i> .	
71 ACOUSTICS	265
Includes sound generation, transmission, and attenuation. For noise pollution see <i>45 Environment Pollution</i> .	
72 ATOMIC AND MOLECULAR PHYSICS	271
Includes atomic structure, electron properties, and molecular spectra.	
73 NUCLEAR AND HIGH-ENERGY PHYSICS	N.A.
Includes elementary and nuclear particles; and reactor theory. For space radiation see <i>93 Space Radiation</i> .	
74 OPTICS	272
Includes light phenomena and optical devices. For lasers see <i>36 Lasers and Masers</i> .	
75 PLASMA PHYSICS	272
Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see <i>46 Geophysics</i> . For space plasmas see <i>90 Astrophysics</i> .	
76 SOLID-STATE PHYSICS	273
Includes superconductivity. For related information see also <i>33 Electronics and Electrical Engineering</i> and <i>36 Lasers and Masers</i> .	
77 THERMODYNAMICS AND STATISTICAL PHYSICS	274
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also <i>25 Inorganic and Physical Chemistry</i> and <i>34 Fluid Mechanics and Heat Transfer</i> .	
SOCIAL SCIENCES	
80 SOCIAL SCIENCES (GENERAL)	274
Includes educational matters.	
81 ADMINISTRATION AND MANAGEMENT	275
Includes management planning and research.	
82 DOCUMENTATION AND INFORMATION SCIENCE	277
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see <i>61 Computer Programming and Software</i> .	
83 ECONOMICS AND COST ANALYSIS	278
Includes cost effectiveness studies.	
84 LAW, POLITICAL SCIENCE AND SPACE POLICY	279
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.	
85 URBAN TECHNOLOGY AND TRANSPORTATION	282
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see <i>03 Air Transportation and Safety</i> , <i>16 Space Transportation</i> , and <i>44 Energy Production and Conversion</i> .	

SPACE SCIENCES For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL)	282
89 ASTRONOMY	283
Includes radio, gamma-ray, and infrared astronomy; and astrometry.	
90 ASTROPHYSICS	283
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also <i>75 Plasma Physics</i> .	
91 LUNAR AND PLANETARY EXPLORATION	285
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see <i>18 Spacecraft Design, Testing and Performance</i> .	
92 SOLAR PHYSICS	285
Includes solar activity, solar flares, solar radiation and sunspots. For related information see <i>93 Space Radiation</i> .	
93 SPACE RADIATION	285
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see <i>52 Aerospace Medicine</i> . For theory see <i>73 Nuclear and High-Energy Physics</i> .	

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL	286
SUBJECT INDEX	A-1
PERSONAL AUTHOR INDEX	B-1
CORPORATE SOURCE INDEX	C-1
FOREIGN TECHNOLOGY INDEX	D-1
CONTRACT NUMBER INDEX	E-1
REPORT NUMBER INDEX	F-1
ACCESSION NUMBER INDEX	G-1
APPENDIX	APP-1

TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
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ON MICROFICHE

ACCESSION NUMBER → **N92-33139*** # National Aerospace Lab., Amsterdam (Netherlands). ← CORPORATE SOURCE
Structures and Materials Div.

TITLE → **GLOBAL/LOCAL INTERLAMINAR STRESS ANALYSIS OF A GRID-STIFFENED COMPOSITE PANEL**

AUTHORS → J. F. M. WIGGENRAAD and N. R. BAULD, JR. (Clemson Univ., SC.) 30 May 1991 21 p Presented at the 6th American Society for Composites Technical Conference, Albany, NY, 6-9 Oct. 1991

PUBLICATION DATE → (Contract NAS1-17925)

REPORT NUMBERS → (NASA-CR-190822; NAS 1.26:190822; NLR-TP-91052-U; ETN-92-91996) Avail: CASI HC A03/MF A01

AVAILABILITY SOURCE

A global/local procedure for the computation of the interlaminar stress components at the skin wrap, skin core, and wrap core interfaces for an advanced concept stiffened panel, is described. The procedure consists of a global model of two dimensional shell elements that is used to design a grid stiffened panel with blade type stiffeners, a local model of three dimensional solid elements that is used to compute interlaminar stress components, and a scheme devised to assign displacement boundary conditions for a local model that are based on displacement and rotation data of a few nodes of the global model. A global panel was designed according to strength, stiffness, and stability criteria associated with the design of traditional aircraft wing panels. Interlaminar normal and shearing stress components, computed via the local model, were found to be well below typical tensile normal and shearing strengths of a graphite epoxy material.

ESA

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED
↓

ACCESSION NUMBER → **A92-53080*** National Aeronautics and Space Administration. ← CORPORATE SOURCE
Langley Research Center, Hampton, VA.

TITLE → **NONLINEAR DEVELOPMENT AND SECONDARY INSTABILITY OF LARGE-AMPLITUDE GOERTLER VORTICES IN HYPERSONIC BOUNDARY LAYERS**

AUTHORS → Y. FU and P. HALL (Manchester, Victoria University, United Kingdom) European Journal of Mechanics, B/Fluids (ISSN 0997-7546), vol. 11, no. 4, 1992, p. 465-510. refs

AUTHOR'S AFFILIATION

JOURNAL TITLE

PUBLICATION DATE

(Contract NAS1-18605; NAS1-18107; AF-AFOSR-89-0042)
Copyright

The weakly nonlinear development of large-amplitude Goertler vortices in a small neighborhood of the neutral stability position given by the linear theory is considered. It is shown that if the basic state and the wall curvature satisfy a certain condition, the Goertler vortices will grow until they become so large as to drive a mean flow correction as large as the basic state. Attention is then given to the further downstream evolution of these large-amplitude vortices, and it is shown that the vortices have a triple layer structure which consists of a region of vortex activity bounded by two transition layers over which the amplitude of the harmonic part of the vortex decays to zero exponentially. The positions of the two transition layers are found to be governed by a free boundary problem, which is solved for a number of curvature distribution cases. The secondary instability of the two transition layers is investigated with respect to traveling waves which are $\pi/2$ out of phase in the spanwise direction with the steady Goertler vortices.

V.L.

EUROPEAN AEROSPACE SCIENCE AND TECHNOLOGY 1992

A Bibliography with Indexes

JUNE 1993

01

AERONAUTICS (GENERAL)

A92-14348

REQUIREMENTS AND POSSIBLE TECHNICAL SOLUTIONS DERIVED FROM THE NEW AIRMOBILITY CONCEPT OF THE GERMAN ARMY

R. D. VON RETH and H. KOEHLER (MBB GmbH, Ottobrunn, Federal Republic of Germany) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 1. Alexandria, VA, American Helicopter Society, 1991, p. 319-335.

Copyright

The present study has attempted to treat all facets of the German Army's 'airmobility' concept simultaneously and derive a harmonized set of recommendations. The modeling tools employed in this evaluation included interactive battlefield simulation. Attention is given to the contributions available from multisensor scout helicopters, reduced-observables troop-carrying helicopters, Tiger-derived combat helicopters, and tilt-rotor VTOL tactical transports. O.C.

A92-14447

P120 PROGRAMME - FIRST RESULTS OF THE PRE-DEVELOPMENT PHASE

M. RUSSIER (Aerospatiale, Division Helicoptere, Marignane, France) AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Paper. 9 p. refs

The history of helicopter development at Aerospatiale is briefly reviewed, and the current P120 development program is discussed in some detail. The discussion covers the technological approach, the program schedule, architecture and operational aspects, and general technical and performance characteristics of the P120. The technical description of the P120 helicopter covers the main rotor, the fenestron tail rotor, and the structure. V.L.

A92-17095

AIR TRANSPORT RESEARCH IN GERMANY [LUFTFAHRTFORSCHUNG IN DEUTSCHLAND]

HEINZ MAX (DLR, Cologne, Federal Republic of Germany) Luft- und Raumfahrt (ISSN 0173-6264), vol. 12, Sept.-Oct. 1991, p. 22-25. In German.

Copyright

The medium-range research program being carried out by the German Research Institute for Aviation and Space Flight is discussed. This paper outlines the main areas of research being carried out in this program, including both rigid body aircraft and helicopters. C.D.

A92-17854#

POTENTIAL HYPERSONIC VEHICLES APPLICATIONS

GERARD LARUELLE (Aerospatiale, Les Mureaux, France) and PHILIPPE RAMETTE (Dassault Aviation, Saint-Cloud, France) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 8 p. refs
(AIAA PAPER 91-5086) Copyright

Applications of the vehicles are given including missiles, reconnaissance, commercial transportation, military aircraft, and airbreathing space launchers. The convergence of technological and economic issues is considered along with need in justifying the importance of the aircraft and spacecraft. Key technological issues include propulsion systems, resistant materials, low-mass structures, and guidance equipment for the thermal environment. Hypersonic missiles and reconnaissance vehicles are described and include the Scorpion airbreathing missile, and commercial applications include the Concorde and the Alliance aircrafts. Technological advances are cited for developing space launchers, and design studies are mentioned for advanced SSTD and TSTD launchers such as the Taranis, Oriflamme, and STS 2000.

C.C.S.

A92-21014

AIR TRANSPORT RESEARCH IN GERMANY [LUFTFAHRTFORSCHUNG IN DEUTSCHLAND]

HEINZ MAX (DLR, Cologne, Federal Republic of Germany) Luft- und Raumfahrt (ISSN 0173-6264), vol. 12, Nov.-Dec. 1991, p. 42-44. In German. refs

Copyright

The major lines of aircraft engine research in Germany are briefly reviewed. The distribution of resources among these lines of research is pointed out. C.D.

A92-21700

CLEVER COCKPITS

GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, Jan. 8, 1992, p. 19, 20, 22, 24.

Copyright

Ultra-fast computers connected by high-capacity fiber-optic data networks will transform future USAF and Army aircraft into new powerful information processing machines rather than loose collections of uncommunicative microchips. New packaging, as much as any single avionics advance, will improve maintainability and enhance reliability. The YF-22 has demonstrated the vehicle management system that integrates control of the aircraft's many subsystems, including its FBW flight controls. Several other examples are given, including the Longbow radar that will supplement the primary electrooptical targeting systems on both the Comanche and Apache helicopters, detecting and classifying armored targets in conditions where IR visibility is degraded.

R.E.P.

A92-25178

A COGNITIVE TEMPORAL MODEL FOR THE PLANNING IN AIRCRAFT MAINTENANCE

DENYS BERNARD (SOGERMA-SOCEA, Merignac, France), MARIO BORILLO, and BRUNO GAUME (Toulouse III, Universite, France) IN: IEA/AIE-90; Proceedings of the 3rd International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, Charleston, SC, July 15-18, 1990. Vol. 1. Tullahoma, TN, University of Tennessee, 1990, p. 318-324. refs

Copyright

Key maintenance issues are addressed by employing the temporal reasoning model by Kowalski and Sergot (1986) based on events calculus and applying the treatment temporal information relating to aircraft overhaul. The planning problem inherent in

01 AERONAUTICS (GENERAL)

aircraft maintenance is defined so that planning issues specific to the field can be incorporated. The model is outlined and generalized, and the maintenance-specific terms and rules are set forth with a sample application. The technique permits the reading of the provisional schedule, the identification of time intervals, and the description of the progress of the maintenance. The cognitive approach extends the reasoning model in a manner that is consistent with conventional human-planning methodologies. The default reasoning model is nonmonotonic, and the task list can be expanded and updated without influencing current data.

C.C.S.

A92-25180

THE TSE 310 TROUBLESHOOTING EXPERT PROTOTYPE FOR THE AIRBUS A-310 COMMERCIAL AIRCRAFT

MEHMET H. GOKER and SELAHATTIN KURU (University of the Bosphorus, Istanbul, Turkey) IN: IEA/AIE-90; Proceedings of the 3rd International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, Charleston, SC, July 15-18, 1990. Vol. 2. Tullahoma, TN, University of Tennessee, 1990, p. 692-696. Research supported by University of the Bosphorus. refs

Copyright

Using available troubleshooting manuals, mean time between failure data, and the maintenance record of each aircraft the troubleshooting process of an Airbus A-310 is being automated by implementing an expert system (TSE 310). Starting off with the basic troubleshooting tree in the troubleshooting manual the program uses last removal date and mean time between failure data to calculate failure probabilities of the parts connected to the relevant node of the troubleshooting tree, and by using these probabilities traverses the rest of the tree in an intelligent manner to locate the faulty part requiring minimum user intervention.

Author

A92-25575

ANGLO-AMERICAN AVIONICS

PETER A. HEARNE Aerospace (UK) (ISSN 0305-0831), vol. 19, Feb. 1992, p. 12-18.

Copyright

An overview is presented of some of the military and civil aviation technical developments that have been accomplished by the special Anglo-American relationship. Attention is given to avionics developments including the Lightning integrated flight control/radar/flight instruments and weapon system and the U.S. Navy's F-14, where the performance of the aircraft, its 100-mile radar, and its long-range Phoenix missile were developed from the beginning as an integrated whole in which aircraft, missile, and electronic system were carefully optimized to meet the point defense problem. Consideration is given to joint endeavors in the fields of integrated circuit semiconductors, digital computing, software systems design, and reliability engineering.

R.E.P.

A92-26793

SUPERSONIC TRANSPORT IN THE 21ST CENTURY

DUDLEY COLLARD (Aerospatiale, Toulouse, France) ICAO Journal (ISSN 0018-8778), vol. 47, Jan. 1992, p. 8, 9.

Copyright

It is stated that market studies indicate a requirement for a long-range SST, but such an undertaking will not be possible without extensive international cooperation to develop an environmentally acceptable aircraft. Consideration is given to the potential market, environmental aspects, engine emissions and noise, technical development, and international cooperation.

R.E.P.

A92-28184

THE OTHER MISSILES

GRAHAM WARWICK, SIMON ELLIOTT, and GILBERT SEDBON Flight International (ISSN 0015-3710), vol. 141, Feb. 26, 1992, p. 34-36.

Copyright

A review is presented of recent developments in aircraft guns

and cannon for operation in the next generation of the world's combat aircraft and helicopters. In this period of advanced missile and weapon systems, aircraft-gun manufacturers are planning to utilize emerging enhanced technologies which change guns radically. Attention is given to cased-telescoped ammunition technology which can be tailored for a light, high-velocity, or heavy, long-range, round. Consideration is given to electromagnetic and electrothermal-chemical guns employing either coil-gun or rail-gun technology that will require development of compact, high-energy electric motors and generators.

R.E.P.

A92-28941

36TH ROY CHADWICK LECTURE - MANUFACTURING BREAKOUT 1941-1991: DEVELOPMENT IN AEROSPACE INDUSTRY MANUFACTURING TECHNIQUES

P. H. SUMMERFIELD (British Aerospace, PLC, Woodford, England) Aeronautical Journal (ISSN 0001-9240), vol. 96, Feb. 1992, p. 35-46. refs

Copyright

A development history is presented for the refinement of design-to-manufacture aircraft production management, over the course of a half century that was initiated by the efforts of the Avro Lancaster bomber's development. Many recent concepts of design-for-manufacture were presciently identified by Davies (1939) in time for incorporation into Lancaster production management. An evaluation is made of subsequent progress and of the prospective economies derivable from more aggressive implementation of (1) statistical quality control, (2) time as the unit for cost-accounting, (3) modular organization of manufacturing processes, and (4) a systems approach to management.

O.C.

A92-30092

AIRBUS - THE FAMILY EXPANDS

KEN ELLIS Air International (ISSN 0306-5634), vol. 42, March 1992, p. 133-137.

Copyright

A review is presented of the development of the various Airbus commercial transport aircraft derivatives from the first A300B in 1972 to the latest A340 now flying. Consideration is given to the marketing surveys and management decisions that have led to the production of the numerous variations of the basic airframe for freighting, military applications and the Super Transporter that will replace the Super Guppy for parts shipments from the consortium partners to the final assembly plant. Attention is given to some future derivatives including a 600 plus seater that might incorporate a 'double-bubble' fuselage configured either vertically or horizontally.

R.E.P.

A92-33430

AN AIRCRAFT MANUFACTURER'S PERSPECTIVE

O. F. BLEEKER and E. JESSEE (Fokker Aircraft, Amsterdam, Netherlands) IN: Radio Technical Commission for Aeronautics, Technical Symposium, Washington, DC, Nov. 18-20, 1991, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1991, p. 91-100.

Copyright

The viable aircraft proposition for the 2000 year market developed by Fokker Aircraft, Netherlands, is discussed with particular attention given to air transport market and air traffic management developments. The future 50-80 passenger air transport mission is characterized by 150-300 nautical miles, at operating cost levels of current turbo-propeller aircraft, with excellent dependability and high productivity. Cost, speed, and time are the major factors in the future aircraft proposition, but the time aspect is considered to be a key element in a successful regional airline market and it is in this area where manufacturers, operators, and the air traffic management have to coordinate their efforts to provide solutions.

O.G.

A92-36350

THE BULLISH BEAR

Flight International (ISSN 0015-3710), vol. 141, no. 4313, April 8,

1992, p. 20-23.

Copyright

This paper examines the decentralized structure and objectives of the Interstate Aviation Committee which replaces Aeroflot as the regulatory body for air transport in the Commonwealth of Independent States. Each nation maintains its own self-financed airline and aircraft register, and a central record is held by the Interstate Aviation Committee. The evolving structure of commercial aviation in the former USSR has significant implications for issues of business and safety, and the lack of equipment in the industry is mentioned.

C.C.S.

A92-37875

NASA'S QUIET SIDE. I

NIGEL MACKNIGHT Air International (ISSN 0306-5634), vol. 42, no. 5, May 1992, p. 240-243.

Copyright

A review is presented of the Quiet Short-Haul Research Aircraft (QSRA), a modified DHC-5 Buffalo developed by a NASA/Boeing team to facilitate investigations of powered-lift technologies that confer exceptional STOL performance and drastically reduce the acoustic 'footprint' an aircraft makes on the ground below. The QSRA's principal feature is its over-the-wing engine installations that permits the turbofan engines to exhaust over the top surface of a wing optimized for powered-lift, generating three times the lift of a conventional wing at low flying speeds. At 48,000 lb, the QSRA's lift-off airspeed is only 71 kts while its landing speed is 65 kts. Attention is given to other operational performance tests including high-descent-rate landing approaches, noise-reduction measurements, Category 3A approaches and landings, and carrier landings and takeoffs without benefit of arresting gear or catapult.

R.E.P.

A92-40880

SHEAR PROGRESS

GUY NORRIS and GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, no. 4315, April 22, 1992, p. 29-31.

Copyright

Advances in aircraft and aircraft-related technologies to recognize and handle windshear are reviewed. Emphasis is placed on progress from reactive to predictive technologies. The role of ground data links in detecting bursts is addressed.

C.D.

A92-41177

THE EVOLUTION FROM BONDED F27 AIRCRAFT TO ARALL STRUCTURES

L. H. VAN VEGGEL (Fokker Aircraft, Amsterdam, Netherlands) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 65-79. refs

The paper describes the applications of the adhesive bonded structures in Fokker F27 and F28 aircraft and the evolution to the use of fiber-reinforced Aramid aluminum laminates (Arall) in more advanced Fokker aircraft. Special attention is given to the material properties and the allowables in the Arall 1 and Arall 2 materials, the Arall wing structures, the end-fitting panels, the designs of the Arall F27 wing panel, and the Fokker 50 flying access doors. Results of design studies performed on an Arall F50 wing structure are presented, with particular consideration given to the Arall F50 wing compression test panel, Fokker 50 spars, and the Fokker 50 fatigue panel. The quality assurance aspects of Arall structures are discussed.

I.S.

A92-41823

THE ASPM PROGRAM [LE PROGRAMME ASPM]

PAUL BERNIER (Aerospatiale, Paris, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 115-118. In French.

Copyright

An overview of the French air/ground missile, ASPM, is presented. Consideration is given to a description of the program, the development and ground tests conducted and the flight tests performed. Flight tests involving missile firing from the ground to

verify the propulsion system, air to ground firing from test aircraft, and operational firing from combat aircraft for final qualification of the system are described.

R.E.P.

A92-44895

ASSEMBLING THE FUTURE

DOUGLAS BARRIE Flight International (ISSN 0015-3710), vol. 141, no. 4322, June 10, 1992, p. 50-52.

Copyright

An overview is presented of the expansion work currently in progress to handle final assembly of A321 aircraft, which program has recently been awarded to Deutsche Airbus. Consideration is given to the primary contractors and the major subassemblies of the A321 and how the various sections will be handled to achieve final assembly.

R.E.P.

A92-45302

INTERNATIONAL POWERED LIFT CONFERENCE, LONDON, ENGLAND, AUG, 29-31, 1990, PROCEEDINGS

Conference sponsored by Royal Aeronautical Society. London, Royal Aeronautical Society, 1990, 375 p. For individual items see A92-45303 to A92-45325.

(ISBN 0-903409-68-2) Copyright

The present volume on powered lift discusses U.S. Air Force STOVL activities, jet-powered V/STOL aircraft, the Harrier international program, and V/STOL engine design evolution. Attention is given to a remote tip-driven fan-powered supersonic fighter concept, the military utility of medium-speed V/STOL design, ASTOVL flexibility in the 21st century, and a USAF assessment of STOVL fighter options. Topics addressed include the evolution of ASTOVL aircraft design, ASTOVL propulsion systems configuration and concept choice, recent developments at the Shoeburyness STOVL test facility, and configuration effects on the ingestion of hot gas into the engine intake. Also discussed are hot gas ingestion characteristics and flow visualization of a vectored thrust STOVL concept, the progress of the ASTOVL control concept studies under the VAAC program, ASTOVL engine control, small-scale experiments in STOVL ground effects, and numerical simulation of powered-lift flows.

C.A.B.

A92-46448

SUNRISE AEROSPACE

KEVIN O'TOOLE Flight International (ISSN 0015-3710), vol. 141, no. 4321, June 3, 1992, p. 23-25.

Copyright

An overview is presented that examines the growth and dominance in productivity that Japan has achieved in the automotive, computer and consumer electronics fields. The potential and future role of the aerospace industry in the major countries of the Pacific Rim is examined.

R.E.P.

A92-47592

GERMAN-GUS COOPERATION IN CIVIL AVIATION [KOOPERATION DEUTSCHLAND-GUS IN DER ZIVILEN LUFTFAHRT]

MICHAEL HAUGER Luft- und Raumfahrt (ISSN 0173-6264), vol. 13, no. 3, May-June 1992, p. 16-18, 20, 22, 23. In German.

Copyright

German-Russian cooperation in the development of aircraft technologies is discussed. Emphasis is given to plans for a hydrogen-fueled 'cryoplane' and the MTU-CRISP propfan. The economic costs of these developments are addressed.

C.D.

A92-47774

INDUSTRIAL PRACTICE IN AERONAUTICAL MAINTENANCE [PRATIQUES INDUSTRIELLES EN MAINTENANCE AERONAUTIQUE]

M. C. LECLERCQ and G. MERET (Air France, Direction du Materiel, Orly) (Societe Francaise des Mecaniciens and FIMTM, Journees sur l'Integrite des Structures, Courbevoie, France, Apr. 18, 19, 1991) Revue Francaise de Mecanique (ISSN 0373-6601), no. 1, 1992, p. 45-47. In French.

Copyright

01 AERONAUTICS (GENERAL)

A review is presented covering industry practices in the area of aircraft maintenance. An example is given showing that a 747 aircraft undergoes 16 hours of maintenance for every hour of flight. Maintenance time is broken down into the various hours spent on light maintenance and heavy maintenance for airframe and engines and other major components. R.E.P.

A92-47821

CIS ENGINES. I - THE RANGE REVEALED

KEN FULTON Air International (ISSN 0306-5634), vol. 43, no. 1, July 1992, p. 34-39.
Copyright

A review is presented of the background and development of current production engines being offered by the aerospace industries of Russia and Ukraine. The restructuring of the various principal engine design bureaus, manufacturing plants, and the aggregate plants producing engine fuel and control system components, and other system devices is described. Current gas turbine and piston engines are listed showing maximum takeoff thrust and aircraft applications. R.E.P.

A92-48587

TRENDS IN COMMERCIAL AIRCRAFT DESIGN - WHAT EVOLUTION FACTORS AND WHAT APPROACH?

JEAN-PIERRE MAREC (ONERA, Chatillon, France) ONERA, TP no. 1992-25, 1992, 40 p. Translation. Previously cited in issue 09, p. 1304, Accession no. A91-26087.
(ONERA, TP NO. 1992-25)

A92-51808

SUCCESSFUL TRANSFER OF TECHNOLOGY FROM A RESEARCH AND DEVELOPMENT LABORATORY TO AN AEROSPATIALE PRODUCTION UNIT

S. ZOLOTOVSKY (Aerospatiale, Centre Louis Bleriot, Suresnes, France) and B. MIGUET (Aerospatiale, Toulouse, France) IN: Welding in space and the construction of space vehicles by welding; Proceedings of the Conference, New Carrollton, MD, Sept. 24-26, 1991. Miami, FL, American Welding Society, 1991, p. 106-143.
Copyright

The osmosis of the 'Louis Bleriot' Joint Research Center and the Aerospatiale production unit in Toulouse St. Eloi has made it possible for Laser CO2 cutting and welding technologies to become a reality and be incorporated into the assembly lines for aircraft structures belonging to the Airbus family. The integration of the two 5-axis, robotized laser cells in direct combination with computers and CAD systems produces extremely diverse unit parts at a high production rate. The reliability and savings provided by this technique make it possible to very quickly recoup investments which are entirely compatible with mass production. Author

A92-53250

RUSSIAN REALITIES

PAUL DUFFY Flight International (ISSN 0015-3710), vol. 142, no. 4329, July 29, 1992, p. 23-25.
Copyright

An overview is presented of the Aviastar Aviation Complex in Ulyanovsk to evaluate how this organization has faced up to the changing political and economic circumstances affecting the aviation industry in Russia. Attention is given to the restructuring, not only of the basic infrastructure of the complex, but of the personnel/management organization which is now based on Western design, development and manufacturing system guidelines. Consideration is given to the ongoing negotiations with other international aeronautics firms and to the projects currently being pursued including the Thermoplane, a rigid-structure airship heavy-lifter. R.E.P.

A92-56277

REPAIR PROCEDURES FOR ADVANCED COMPOSITES FOR HELICOPTERS

HERMANN ESCHBAUMER (MBB GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 23 p. Previously announced in STAR as N92-29874.

Standard repair procedures and the various solutions determined for structural repairs are discussed. Repairs on load introduction areas and extensive damages were rated to require specific repairs and therefore assistance of stress design. Specific repairs are not discussed. Standard repairs applicable for primary and secondary structures are referred to. The difference between 'in house repairs', 'depot and on aircraft repairs', and 'field repairs' are clarified. Suitable nondestructive test techniques for nonstationary inspection are considered and aspects to transfer the required standard repair procedures to maintenance personnel are discussed. Author

A92-56299

THE EUROFAR PROGRAM - AN EUROPEAN OVERVIEW ON ADVANCED VTOL CIVIL TRANSPORTATION SYSTEM

J. RENAUD (Aerospatiale, Paris, France), H. HUBER (MBB GmbH, Ottobrunn, Germany), and G. VENN (Westland Helicopters, Ltd., Yeovil, United Kingdom) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 10 p. refs

A summary is presented of several European overviews of three years of activity on the development of an advanced VTOL civil transportation system based on tilt-rotor (the Eurofar program). The vehicle requirements, the design process, the aircraft performance, and the technological innovations introduced during the development process are described. Special attention is given to the conditions for the acceptance of the tilt-rotor aircraft as a civil transportation vehicle, including the cost efficiency, the safety requirements, and the civil marketing issues involved in the transportation system introduction. I.S.

A92-56304

MODERN HELICOPTER TECHNOLOGIES AT MBB AND THE APPLICATION IN FUTURE PROGRAMMES

WERNER REINL (MBB GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 20 p. refs

The history of helicopter technologies in Germany is briefly reviewed, and current helicopter activities at MBB are discussed. Attention is given to the principal technology programs covering rotor technology, vibration suppression, advanced composite airframes, avionics/cockpits, and flight controls. Consideration is also given to the current status and future prospects of civilian and military helicopter projects, such as BO108, PAH2, NH90, and ALH. V.L.

A92-56306

ORGANIZATION AND TECHNICAL STATUS OF THE NH90 EUROPEAN HELICOPTER PROGRAMME

J. P. BARTHELEMY, R. D. VON RETH (NH Industries, Aix-en-Provence, France), and G. BEZIAC (Aerospatiale, Marignane, France) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 14 p. refs

Design considerations and mission profiles are described that guide the development of the NH90 European helicopter, and attention is given to the structure and results of the development. French, Italian, German, and Dutch contributions to the program are outlined, and the NH90 missions include those for tactical transport, frigate, and search and rescue types. General aircraft specifications are reported emphasizing dimensions and performance data. Two engines are expected to be used for the mission types that provide 1500 kW MCP in standard conditions, and advanced technologies are incorporated in the composite blades, modem hub, and the flight controls with higher harmonic control. Also presented are the general systems architecture, core-system avionics, the fly-by-wire control system, and tactical control subsystems. The NH90 family of helicopters is shown to provide good performance characteristics and high survivability for the proposed mission profiles. C.C.S.

A92-56327

TECHNOLOGY EXPLOITATION FOR IN-SERVICE SUPPORT OF FUTURE ROTORCRAFT

B. P. MERCER (RAF, Swanton Morley, United Kingdom) European

Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 9 p. Research supported by Ministry of Defence Procurement Executive, Stewart Hughes, Ltd., Westland Group, PLC, et al.

Advanced technology projects and technical demonstration programs (TDP) which are being examined by the Royal Air Force and the Defence Research Agency to increase the levels of supportability of their rotorcraft are reviewed. It is noted that advanced technology itself will not increase supportability, but through greater cooperation between industrial and military engineers designs will be influenced by the customer at the earliest stages of projects where the greatest cost savings can be made. The change in policy which has placed supportability alongside performance, time, and cost will be a permanent feature of future contracts. The ultimate aim of TDPs is to build a common understanding of in-service support problems and rectify them long before any prototype is developed. O.G.

N92-12538# National Aerospace Lab., Amsterdam (Netherlands).

A KNOWLEDGE-BASED ASSISTANT FOR DIAGNOSIS IN AIRCRAFT MAINTENANCE

M. A. PIERS and J. C. DONKER In AGARD, Machine Intelligence for Aerospace Electronic Systems 7 p Sep. 1991 Copyright Avail: CASI HC A02/MF A03

A feasibility study on the application of knowledge based systems for diagnosis of complaints in aircraft systems is described. The specific application selected for the Knowledge-based Assistant for Diagnosis in Aircraft Maintenance (KADAM) Project is a knowledge based system to be used by ground engineers for troubleshooting of an aircraft air conditioning system. The approach is addressed, and the results, including the design of the proof-of-concept system, are reviewed. Particular attention is paid to the identification and formalization of methods for diagnosis.

Author

N92-12988# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A REVIEW OF UK AVIATION POLICY

ROBERT CAVES Jul. 1991 47 p (TT-9107; ISBN-0-904947-34-3; ETN-91-90293) Copyright Avail: CASI HC A03/MF A01

The background to present aviation policies is discussed and the U.K. (United Kingdom) aviation situation is reviewed. The main aviation issues are discussed in the light of this background. These issues come under the following headings: infrastructure capacity; role of regional airports; airport privatization; environment impact; resources; safety; security; economic regulation; EEC (European Economic Community) harmonization; equal opportunity; general aviation; the civil aviation authority; aviation and the economy; integrated transport; planning methodology; policy formulation. Policy changes are suggested from a synthesis of discussions.

ESA

N92-18322# Manchester Univ. (England). Aeronautical Engineering Group.

THE GOLDSTEIN ENGINEERING RESEARCH LABORATORY

1989 61 p (AERO-REPT-8906; ETN-92-90941) Avail: CASI HC A04/MF A01

The Goldstein Laboratory is situated near Manchester (England). The experimental and computation facilities including an open jet tunnel, low turbulence wind tunnel, shock tubes, small wind tunnels, towing tasks for nonaeronautical fluid phenomena, stratified facilities, pulsating flow rig, and the computer system, are described. Profiles of research staff are given. Recent research programs, including jet noise investigations, computational fluid dynamics, high incidence aerodynamics, pulsating flow in tubes/blood flow in arteries, bluff body wakes, stratified flow, air to air refueling, and vortex dynamics are summarized. ESA

N92-27887# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.

AIR VEHICLE MISSION CONTROL AND MANAGEMENT

Mar. 1992 260 p In ENGLISH and FRENCH The 53d symposium was held in Amsterdam, Netherlands, 22-25 Oct. 1991 (AGARD-CP-504; ISBN-92-835-0662-6; AD-A253088) Copyright Avail: CASI HC A12/MF A03

Presented here are 21 unclassified papers presented at the Guidance and Control Panel Symposium held at the Marine Kazerne, Amsterdam, The Netherlands from October 22 to 25, 1991. Topics covered include operational mission considerations, situation assessment, route planning, mission planning, expert systems, aircraft guidance and control, fuzzy logic, flight control, and trajectories.

N92-29874# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Helicopter Div.

REPAIR PROCEDURES FOR ADVANCED COMPOSITES FOR HELICOPTERS

HERMANN ESCHBAUMER 1991 25 p Presented at the 17th European Rotorcraft Forum, Berlin, Fed. Republic of Germany, 24-26 Sep. 1991 (MBB-UD-0606-91-PUB; ETN-92-91696) Avail: CASI HC A03/MF A01

Standard repair procedures and the various solutions determined for structural repairs are discussed. Repairs on load introduction areas and extensive damages were rated to require specific repairs and therefore assistance of stress design. Specific repairs are not discussed. Standard repairs applicable for primary and secondary structures are referred to. The differences between 'in house repairs', 'depot and on aircraft repairs', and 'field repairs' are clarified. Suitable nondestructive test techniques for nonstationary inspection are considered and aspects to transfer the required standard repair procedures to maintenance personnel are discussed. ESA

N92-30232# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

ACQUISITION OF AN AEROTHERMODYNAMIC DATA BASE BY MEANS OF A WINGED EXPERIMENTAL REENTRY VEHICLE

E. H. HIRSCHER, H. GRALLERT, J. LAFON, and M. RAPUC 19 Aug. 1991 40 p Sponsored in part by ESA (MBB/FE202/S/PUB/461; ETN-92-91903) Copyright Avail: CASI HC A03/MF A01

A winged aerothermodynamic experimental reentry vehicle is proposed in order to verify and validate the methods of numerical aerothermodynamics as design tool additional to the classical tools, i.e., the wind tunnel. Experimental hypersonic vehicles are reviewed and the aerothermodynamic characteristic of reentry vehicles and the ground simulation problems are considered. The possible configuration and trajectory of a winged experimental vehicle are discussed, together with the required and possible measurements, and the data management and recovery. Use of the obtained data base in the establishment of the methods of numerical aerothermodynamics as additional design tool is outlined. ESA

N92-30675# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

NUMERICAL OPTIMIZATION IN GERMANY: A NON-EXHAUSTIVE SURVEY ON CURRENT ACTIVITIES WITH EMPHASIS ON AERONAUTICS

LUCIANO FORNASIER Oct. 1991 21 p Presented at the 3rd International Conference on Inverse Design Concept and Optimization in Engineering Sciences, Washington, DC, 23-25 Oct. 1991 (MBB/FE211/S/PUB/474; ETN-92-91906) Copyright Avail: CASI HC A03/MF A01

Without claim to completeness, some recent progresses achieved in development and application of numerical optimization methods are presented. With emphasis lying on aeronautical problems, the activities in the field of aerodynamic design by

02 AERODYNAMICS

Computational Fluid Dynamics (CFD) methods, structural optimization and determination of optimal flight trajectories are surveyed. As the reviewed methods show different levels of mathematical background, capability, maturity and applicability, the need for a stronger exchange of information and experience between the different disciplines emerges as a key factor for increasing the impact of numerical optimization strategies in the design process. ESA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A92-12649

NUMERICAL SOLUTION OF STEADY INCOMPRESSIBLE VISCOUS FLOWS OVER AIRFOILS

KAREL KOZEL (Czech Technical University, Prague, Czechoslovakia) and TOMAS HULEK Acta Technica CSAV (ISSN 0001-7043), vol. 36, no. 5, 1991, p. 521-533. refs
Copyright

A method of solving 2D steady laminar incompressible viscous flows over airfoils has been developed. The results of tests of the method on NACA 0012 airfoils show good correspondence with expected behavior, and a remarkable dependence of the results on mesh resolution is seen at high Re values close to the limit of the existence of a steady solution. Several relative advantages of the artificial compressibility concept and the time-marching methods are discussed. C.D.

A92-13198

SOLUTION OF THE REYNOLDS-AVERAGED NAVIER-STOKES EQUATIONS FOR TRANSONIC AEROFOIL FLOWS

L. J. JOHNSTON (University of Manchester Institute of Science and Technology, England) Aeronautical Journal (ISSN 0001-9240), vol. 95, Oct. 1991, p. 253-273. refs
Copyright

A computational method to predict the viscous transonic flow developed around two-dimensional aerofoil sections is described. The Reynolds-averaged Navier-Stokes equations applicable to turbulent flow are discretized in space using a cell-centered finite-volume formulation. A multi-stage, explicit, time-marching scheme is used to advance the unsteady flow equations in time to a steady-state solution. Turbulence closure is achieved using either the Baldwin-Lomax algebraic model, or a one-equation model based on the turbulent kinetic energy equation. This latter equation is solved using essentially identical procedures to those for the mean-flow equations. Results are presented for the RAE 2822, RAE 5225, CAST 7 and MBB-A3 transonic aerofoil sections. The relative performance and limitations of the two turbulence models are discussed. Author

A92-13233

BLADE DEFECT FORCE INVESTIGATION IN A COMPRESSOR CASCADE

KRZYSZTOF MAJKA (Koszalin, School of Engineering, Poland) Instytut Maszyn Przepływowych, Prace (ISSN 0079-3205), no. 92, 1990, p. 87-97. refs
Copyright

The paper presents an experimental study of the blade defect forces in a compressor cascade end-wall boundary layer. The experiments were aimed at improving the general understanding of the end-wall flow field and experimentally verifying the concepts and assumptions underlying the turbomachine integral boundary layer theory. Author

A92-13235

ESTIMATION OF THE SIZE OF SEPARATION ZONE IN A TURBINE STAGE UNDER SMALL LOAD [OCENA ROZLEGLOSCI STREFY ODERWANIA STRUMIENIA PRZY MALYCH OBCIAZENIACH STOPNIA TURBINOWEGO]

TADEUSZ CHMIELNIAK and HENRYK LUKOWICZ Instytut Maszyn Przepływowych, Prace (ISSN 0079-3205), no. 92, 1990, p. 113-124. In Polish. refs
Copyright

The paper presents a method of estimating the size of the flow separation zone in turbine stages which are not working under full load. The model of the phenomenon comprises exact equations of radial equilibrium for the axisymmetric flow of wet steam, equation of continuity, equation of state for the liquid and gas phase, and an adequately selected manner of defining the boundary conditions. The dissipative phenomena have been taken into consideration integrally. A general description of the algorithm is shown. In order to solve the equations, the Runge-Kutta method is employed. Results of calculations are presented. Author

A92-13448

SECONDARY SEPARATION FROM A SLENDER WING

K. KIRKKOPRU and N. RILEY (East Anglia, University, Norwich, England) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 25, Nov. 1991, p. 329-352. Research supported by Ministry of Defence Procurement Executive. refs
Copyright

The high Reynolds number laminar flow of an incompressible fluid past a slender delta wing at incidence is considered. The primary separation is represented by vortex sheets emanating from the leading edges. These sheets also carry a source distribution to represent viscous displacement effects. An interactive viscous-inviscid calculation is carried out to determine the secondary-separation flow properties on the wing. Agreement between the theoretical predictions and experiment is encouraging. For example, unlike the purely inviscid calculations, there is only a small pressure recovery beyond the suction peak, as is observed in experiment. Similarly, the upward and inboard movement of the vortex core due to the secondary separation is in accord with experiment, as is the position of secondary separation. Author

A92-13815

INFLUENCE OF THE ENTROPY LAYER ON THE SEPARATION LENGTH IN HYPERSONIC AERODYNAMICS IN THE TRIPLE-DECK FRAMEWORK. II [INFLUENCE DE LA COUCHE D'ENTROPIE SUR LA LONGUEUR DE SEPARATION EN AERODYNAMIQUE HYPERSONIQUE, DANS LE CADRE DE LA TRIPLE COUCHE. II]

PIERRE-YVES LAGREE (Paris VI, Universite, France) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de la Terre et de l'Univers (ISSN 0764-4450), vol. 313, no. 9, Oct. 24, 1991, p. 999-1004. In French. refs
Copyright

Inviscid-viscous interaction on a flat blunt plate in a weak hypersonic regime is examined on the triple-deck scales to delineate the influence of an asymptotically small nose bluntness on the flow structure near a laminar separation. The entropy layer scale is considered to be very small compared to that of the upper deck. The crude chemical effect and nose bluntness are accounted for by modifying the usual pressure-displacement relation. R.E.P.

A92-13816

A SIMPLIFIED MODEL FOR AERODYNAMIC FLOWS AROUND STREAMLINED MODELS [UN MODELE SIMPLIFIE POUR LES ECOULEMENTS AERODYNAMIQUES AUTOUR DE MAQUETTES ELANCEES]

PHILIPPE DESTUYNDER, PHILIPPE DUPUY, and FRANCOISE SANTI (Conservatoire National des Arts et Metiers, Saint-Cyr-l'Ecole, France) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences

de la Terre et de l'Univers (ISSN 0764-4450), vol. 313, no. 9, Oct. 24, 1991, p. 1005-1010. In French. refs
Copyright

By utilizing an asymptotic technique based on a small parameter representing the slenderness of a vehicle, a simplified CFD model is developed. This model comprises three weakly coupled equations of which the first is a one-dimensional convection model in the main flow direction. The two other coupled equations represent a diffusion phenomenon through the cross-sections of the flow.

R.E.P.

A92-14424

LIFTING LINE PREDICTIONS FOR A SWEEPED TIP ROTOR BLADE

COLIN YOUNG (Royal Aerospace Establishment, Farnborough, England), WILLIAM G. BOUSMAN, THOMAS H. MAIER (U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA), FRANCOIS TOULMAY (Aerospatiale, Marignane, France), and NEIL GILBERT (Defence Science and Technology Organisation, Aeronautical Research Laboratory, Melbourne, Australia) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1345-1370. refs

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Four lifting line analyses have been used to calculate the airloads and blade stresses on a swept tip helicopter rotor tested in flight. The capability of the analyses is assessed over a range of advance ratios from low speed flight, where the wake modeling is important, to high speed conditions, where the representation of the blade dynamics and unsteady aerodynamic effects are the dominant features.

Author

A92-15345

A REVIEW OF RIGID BODY RESPONSE ON STING SUPPORTED MODELS AT HIGH ANGLES OF INCIDENCE

D. G. MABEY, B. L. WELSH, and C. R. PYNE (Royal Aerospace Establishment, Bedford, England) Progress in Aerospace Sciences (ISSN 0376-0421), vol. 28, no. 2, 1991, p. 133-170. refs

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The new requirement to test wind tunnel models of combat aircraft at high angles of incidence and high kinetic pressures has led to a review of the factors controlling model stability. Dangerous motions might occur on models at high angles of incidence unless special preventive measures are taken. An internal tuned damper and balance bump stops are recommended to limit the responses. The bump stops prevent the moment limits of the strain gauge balance from being exceeded. The effectiveness of both devices was confirmed by tests on a swept wing model which experienced dangerous bending oscillations in a vertical plane at a Mach number of 0.50 in the incidence range from about 27-29 deg together with dangerous yawing oscillations in a horizontal plane above an incidence of about 35 deg.

Author

A92-15533

TURBINE CASCADE CALCULATIONS THROUGH A FRACTIONAL STEP NAVIER-STOKES ALGORITHM

K. GIANNAKOGLIOU, G. SIMANDIRAKIS, and K. D. PAPAILIOU (Athens, National Technical University, Greece) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. refs (ASME PAPER 91-GT-55)

An explicit, finite-difference, fractional-step Navier-Stokes method is presented for the prediction of two-dimensional turbomachinery cascade flows. The method also accounts for three-dimensional effects due to radius and streamtube thickness variations. The two-layer Baldwin-Lomax algebraic turbulent model is used to effect closure and its practical implementation is discussed in detail. Three different flow problems are examined and compared with experimental and numerical results obtained elsewhere. These cases deal with transonic flows in the last stage of a steam turbine rotor and a low solidity turbine cascade, as well as the subsonic flow around an isolated RAE2822 profile. The latter case was used for comparing two different transition

criteria, implemented in the present code. C-type computational grids are used which are quasi-orthogonal in the near wall region.

Author

A92-15535

TURBULENCE MODELLING FOR SECONDARY FLOW PREDICTION IN A TURBINE CASCADE

J. G. E. CLEAK and D. G. GREGORY-SMITH (Durham, University, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 11 p. Research supported by SERC and Rolls-Royce, PLC. refs (ASME PAPER 91-GT-57)

Predictions of secondary flow in an axial turbine cascade have been made using three different turbulence models; mixing length, a one equation model and a k-epsilon/mixing length hybrid model. The results are compared with results from detailed measurements, not only by looking at mean flow velocities and total pressure loss, but also by assessing how well turbulence quantities are predicted. It is found that the turbulence model can have a big influence on the mean flow results, with the mixing length model giving generally the best mean flow. None of the models give good predictions of the turbulent shear stresses in the vortex region, although the k-epsilon model gives quite good turbulent kinetic energy values. The one equation model is the only one to contain a transition criterion. The importance of such a criterion is illustrated, but the present one needs development to give reliable predictions in the complex flow within a blade passage.

Author

A92-15536

3-D LOSS PREDICTION BASED ON SECONDARY FLOW AND BLADE SHEAR LAYER INTERACTION

D. T. KATRAMATOS (In2Tec, Ltd., Research and Development Dept., Athens, Greece) and J. K. KALDELLIS (Piraeus, University; In2Tec, Ltd., Research and Development Dept., Athens, Greece) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 12 p. refs (ASME PAPER 91-GT-59)

The 3D loss distribution along axial turbomachines has been investigated. For this purpose, a well documented secondary flow calculation method has been interactively coupled with fast blade-to-blade shear layer calculation code, in order to predict the complete secondary flow and profile loss distribution. The blade-to-blade code predicts the profile loss distribution and subsequently provides the correct total pressure field for the secondary flow calculation. The combination of the above-mentioned codes gives a realistic picture of the flow quantities at any S3 surface along a machine at a minimal computer cost. Several test cases, including axial compressor and turbine cascades as well as transonic axial compressor blade rows, have been investigated. The results are in good agreement with the experimental data and are favorably compared with various recent correlations.

Author

A92-15549

QUASI-THREE-DIMENSIONAL CHARACTERISTICS METHOD FOR A SUPERSONIC COMPRESSOR ROTOR

A. BOELCS and V. TSAMOURTZIS (Lausanne, Ecole Polytechnique Federale, Switzerland) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 13 p. refs (ASME PAPER 91-GT-81)

A new quasi-3D characteristics method has been developed to calculate the supersonic flow in a compressor rotor on an axisymmetric stream surface with variable radius and stream tube thickness. The method is valid for supersonic inlet flow with an attached shock wave at the blade leading edge where the inlet Mach number and flow angle are related by the unique incidence condition. On the basis of the quasi-3D characteristics method, a simple quasi-3D method has also been derived that calculates the unique incidence condition and the Mach number distribution on the suction side of the profile for a given stream surface and stream tube thickness. The reliability of the simple method is established by comparing results with those obtained by Denton's

02 AERODYNAMICS

time-marching method as well as those from the quasi-3D characteristics method. Systematic calculations performed using the simple quasi-3D method show the effects of varying the geometrical parameters of the cascade for different stream tube thickness and stream surface radius evolutions through the rotor.

Author

A92-15565

THREE DIMENSIONAL FLOW IN A LINEAR COMPRESSOR CASCADE AT DESIGN CONDITIONS

CH. HIRSCH (Brussel, Vrije Universiteit, Brussels, Belgium) and SHUN KANG (Harbin Institute of Technology, People's Republic of China) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. refs

(ASME PAPER 91-GT-114)

Experimental data measured upstream, inside and downstream of a large-scale linear compressor cascade with NACA 65-1810 blade profile are presented. The flow is surveyed at 15 traverse planes with 14(in half span) x 24(in pitch) points inside a passage, and 14 x 33 points downstream exit plane. The measurements are obtained with a small size five-hole probe, and wall static pressure taps. It is observed that the three-dimensional flow inside and behind the cascade is characterized, not only by the conventional aspects, such as leading edge horseshoe vortices, passage vortices, trailing edge vortex sheet and corner vortices, but also by two spiral node points, formed from the three-dimensional separation lines, on suction surface, and the resulting concentrated vortices.

Author

A92-15569

THE SIMULATION OF THREE-DIMENSIONAL VISCOUS FLOW IN TURBOMACHINERY GEOMETRIES USING A SOLUTION-ADAPTIVE UNSTRUCTURED MESH METHODOLOGY

W. N. DAWES (Cambridge, University, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 11 p. refs

(ASME PAPER 91-GT-124)

This paper presents a numerical method for the simulation of flow in turbomachinery blade rows using a solution-adaptive mesh methodology. The fully three-dimensional, compressible, Reynolds averaged Navier-Stokes equations with k-epsilon turbulence modeling (and low Reynolds number damping terms) are solved on an unstructured mesh formed from tetrahedral finite volumes. At stages in the solution, mesh refinement is carried out based on flagging cell faces with either a fractional variation of a chosen variable (like Mach number) greater than a given threshold or with a mean value of the chosen variable within a given range. Several solutions are presented, including that for the highly three-dimensional flow associated with the corner stall and secondary flow in a transonic compressor cascade, to demonstrate the potential of the new method.

Author

A92-15571

INVISCID-VISCOUS COUPLED SOLUTION FOR UNSTEADY FLOWS THROUGH VIBRATING BLADES. II - COMPUTATIONAL RESULTS

L. HE and J. D. DENTON (Cambridge, University, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 9 p. Research sponsored by Rolls-Royce, PLC. refs

(ASME PAPER 91-GT-126)

A quasi-3D inviscid-viscous coupled approach has been developed for unsteady flows around oscillating blades, as described in Part 1. To validate this method, calculations for several steady and unsteady flow cases with strong inviscid-viscous interactions are performed, and the results are compared with the corresponding experiments. Calculated results for unsteady flows around a bi-convex cascade and a fan tip section highlight the necessity of including viscous effects in predictions of turbomachinery blade flutter at transonic flow conditions.

Author

A92-15603

UNSTEADY EULER CALCULATIONS IN 2-D INTERNAL AERODYNAMICS WITH INTRODUCED VORTICITY

M. HADZIDAKIS, F. KARAGIANNIS, P. CHAVIAROPOULOS, and K. D. PAPAILIOU (Athens, National Technical University, Greece) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 12 p. Research supported by Dassault Aviation. refs

(ASME PAPER 91-GT-168)

This paper presents an implicit finite difference algorithm which solves the unsteady Euler equations in two-dimensional ducts. The unsteady nature of the flow is due to the time dependent inflow and outflow boundary conditions, while the geometry does not change in time. The present work is based on the Helmholtz decomposition of the unsteady velocity field into a potential and a rotational part. Vorticity is introduced at the inlet by means of velocity, total enthalpy or even entropy slope. The presented results cover a wide range of reduced frequencies in the subsonic regime.

Author

A92-15613

AN EXPERIMENT ON UNSTEADY FLOW OVER AN OSCILLATING AIRFOIL

L. HE and J. D. DENTON (Cambridge, University, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. Research supported by Rolls-Royce, PLC. refs

(ASME PAPER 91-GT-181)

In order to enhance understanding of viscous-dominated blade flutter and to provide experimental data for validating unsteady viscous-flow solutions, unsteady flow over a 2D NACA-65 airfoil oscillating in torsion at an amplitude of 2 deg and a reduced frequency up to 0.69 is experimentally investigated in a low-speed wind tunnel under different loading conditions. Unsteady pressure distribution is measured on both suction and pressure surfaces using pressure transducers. On the suction surface hot-film measurements are conducted to indicate the development of the unsteady boundary layer. Unsteady boundary-layer behavior and its effects on the airfoil's aeroelasticity at the different loading conditions are demonstrated. The results also throw some light on understanding the onset mechanism of 'dynamic stall' which involves a persistent convective pressure-wave pattern with marked unstable aeroelastic characteristics.

Author

A92-15689

TRANSONIC AND SUPERSONIC INVISCID COMPUTATIONS IN CASCADES USING ADAPTIVE UNSTRUCTURED MESHES

F. BASSI (Catania, Università, Italy), S. REBAY (Milano, Politecnico, Milano, Italy), and M. SAVINI (CNR, CNPM, Peschiera Borromeo, Italy) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 10 p. refs

(ASME PAPER 91-GT-312)

The paper describes a solution procedure for two dimensional compressible inviscid flows. The solution algorithm uses a finite volume spatial discretization on unstructured grids of triangles and an explicit Runge-Kutta time marching scheme; for steady problems efficiency is enhanced by using local time stepping and enthalpy damping. The use of unstructured meshes automatically adapted to the solution allows arbitrary geometries and complicated flow features to be treated easily and with high degree of accuracy, even if more work is needed to reach a computational efficiency comparable to those of existing structured codes. Adaptation criteria based on error estimates of significant flow variables have been implemented and tested. The method has been applied to the computation of transonic and supersonic flows in gas turbine nozzles and in impulse rotor cascades for spatial applications and the results have been compared with the experimental data.

Author

A92-15690* Florence Univ. (Italy).

TRANSONIC CASCADE FLOW PREDICTION USING THE NAVIER-STOKES EQUATIONS

A. ARNONE and S. S. STECCO (Firenze, Università, Firenze,

Italy) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. Research supported by NASA and MPI. refs
(ASME PAPER 91-GT-313)

This paper presents results which summarize the work carried out during the last three years to improve the efficiency and accuracy of numerical predictions in turbomachinery flow calculations. A new kind of nonperiodic c-type grid is presented and a Runge-Kutta scheme with accelerating strategies is used as a flow solver. The code capability is presented by testing four different blades at different exit Mach numbers in transonic regimes. Comparison with experiments shows the very good reliability of the numerical prediction. In particular, the loss coefficient seems to be correctly predicted by using the well-known Baldwin-Lomax turbulence model. Author

A92-15718

DESIGN AND PERFORMANCE OF ADVANCED BLADING FOR A HIGH-SPEED HP COMPRESSOR

R. B. GINDER (Royal Aerospace Establishment, Farnborough, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. Previously announced in STAR as N91-30146. refs
(ASME PAPER 91-GT-374) Copyright

A set of advanced blading was designed for a five stage high speed research cone compressor. The blade profiles were aerodynamically tailored using a sophisticated quasi three dimensional S1-S2 flow calculation system. This system involves iteration between blade to blade calculations using an inviscid viscous code, and a streamline curvature calculation for the pitchwise averaged throughflow. The design and measured performance of the new compressor are compared with an initial conventionally bladed four stage version. The new design achieved a peak level of polytropic efficiency approaching 91 percent, a substantial improvement on the initial version, but showed a shortfall in pressure ratio compared with design intent. Post test analyses based on measured performance data are used to give further insight into this result and indicate possible improvements in the design approach. Author

A92-16093

PREDICTION OF GENERALIZED AERODYNAMIC FORCES FOLLOWING LINEARIZED SUPERSONIC THEORY

A. DUGEAI (ONERA, Chatillon, France) (International Forum on Aeroelasticity and Structural Dynamics, Aachen, Federal Republic of Germany, June 3-6, 1991) ONERA, TP no. 1991-114, 1991, 12 p. refs
(ONERA, TP NO. 1991-114)

This paper presents the numerical tools which have been developed at ONERA's structural division in order to calculate generalized aerodynamic forces for supersonic aircrafts. A new method is described which is able to calculate aerodynamic forces for bodies following supersonic linearized theory. This method is a mixed finite element-integral equation method whose main features are identical in the steady and in the unsteady cases. The Green's formulation of the linearized problem is treated in a variational way, and it is projected in an approximation space where the unknowns are the values of the potential at each node of a triangular mesh approximating the surface of the body. Author

A92-16102

HIGH-SPEED IMPULSIVE NOISE AND AERODYNAMIC RESULTS FOR RECTANGULAR AND SWEEPED ROTOR BLADE TIP TESTS IN S1-MODANE WIND TUNNEL

C. POLACSEK and P. LAFON (ONERA, Chatillon, France) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-27, 1991) ONERA, TP no. 1991-124, 1991, 10 p. refs
(ONERA, TP NO. 1991-124)

This paper presents acoustic and aerodynamic results obtained by comparing two four-bladed rotors equipped with different sets of blade tip shapes: rectangular (rotor 7A) and sweptback with

anhedral (rotor 7AD). The data analysis makes it possible to compare the aerodynamic performance of the two rotors and to verify that the shock delocalization in the forward direction is decreased with the sweptback parabolic tip blades (7AD). A gain of 8 dBA on sound pressure level (SPL) is obtained just before delocalization with the rotor 7AD, and the aerodynamic efficiency is improved too. It confirms the interest of the dihedral concept. Aerodynamic and acoustic results constitute a data base for the validation of computer codes under development. Author

A92-16107

THREE-DIMENSIONAL THIN-LAYER AND SPACE-MARCHING NAVIER-STOKES COMPUTATIONS USING AN IMPLICIT MUSCL APPROACH - COMPARISON WITH EXPERIMENTS AND EULER COMPUTATIONS

M. BORREL, P. D'ESPINEY, and C. JOUET (ONERA, Chatillon, France) (Gesellschaft fuer angewandte Mathematik und Mechanik, Royal Academy of Sciences, U.S. Navy, et al., Conference on Numerical Methods in Fluid Dynamics, 9th, Lausanne, Switzerland, Sept. 25-27, 1991) ONERA, TP no. 1991-131, 1991, 11 p. Research supported by DRET. refs
(ONERA, TP NO. 1991-131)

A space-marching and a thin-layer Navier-Stokes unsteady method is presented for supersonic laminar flows. The numerical scheme is based on an upwind implicit scheme for the convective and pressure terms and a centered approximation for the viscous terms. Results on vortex flows around a fuselage with a lenticular section, are compared with available experimental data and with Euler results. To obtain the right vortex pattern, it was found essential to take into account the viscous effects and to use a refined-enough grid. Author

A92-16122

DETAILED ANALYSIS OF WING-NACELLE INTERACTION FOR COMMERCIAL TRANSPORT AIRCRAFT [ANALYSE DETAILLEE DE L'INTERACTION VOILURE-NACELLE D'UN AVION DE TRANSPORT CIVIL]

J. L. GODARD, O.-P. JACQUOTTE (ONERA, Chatillon, France), and D. GISQUET (Aerospatiale, Toulouse, France) (NATO, AGARD, Symposium, Fort Worth, TX, Oct. 7-10, 1991) ONERA, TP no. 1991-152, 1991, 12 p. In French. refs
(ONERA, TP NO. 1991-152)

An experimental setup has been developed to study the wing-nacelle interaction of commercial transports during transonic operation. This stand allows the measurement of the overall loads, pressure distribution on the model, and velocities in the field by laser velocimetry. The analysis gives a better understanding of the wing-nacelle interaction and provides the best comparative elements for modeling calculations. R.E.P.

A92-16125

FORMULATION OF A SIMPLIFIED MODEL OF ROTOR-HORIZONTAL STABILIZER INTERACTIONS AND COMPARISON WITH EXPERIMENTAL MEASUREMENTS

S. WEINSTOCK (ONERA, Chatillon, France) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-27, 1991) ONERA, TP no. 1991-157, 1991, 20 p. refs
(ONERA, TP NO. 1991-157)

The aerodynamic interactions of the rotor wake on the horizontal stabilizer can affect strongly the longitudinal dynamics of a helicopter. A good representation of this phenomenon is necessary for helicopter flight mechanics simulation models. A simple rotor wake model using vortex rings is developed in order to calculate these interactions. The results of this model are compared with the experimental measurements conducted at the ONERA S2-Ch wind tunnel on a motorized helicopter scaled model. Author

A92-16129

THE SONIC BOOM AND PROBLEMS RELATED TO SUPERSONIC FLIGHTS OF MILITARY AIRCRAFT [LE BANG ET LES PROBLEMES LIES AUX VOLS SUPERSONIQUES DES AVIONS MILITAIRES]

CHRISTIAN THERY and CLAUDE LECOMTE (ONERA, Chatillon,

02 AERODYNAMICS

France) (NATO, AGARD, Meeting, Bonn, Federal Republic of Germany, Oct. 21-25, 1991) ONERA, TP no. 1991-162, 1991, 25 p. In French. refs
(ONERA, TP NO. 1991-162)

The principal features of sonic boom propagation, methods of calculation and some experimental results are presented. The various forms that these booms can take are described, i.e., normal boom and focused booms. Ground effects of sonic booms on populations and structures are discussed and some suggestions are offered on the conduct of overland supersonic flights. R.E.P.

A92-16133

SUPERSONIC STATOR-ROTOR INTERACTION IN A TURBINE STAGE

GILLES BILLONNET (ONERA, Chatillon, France) (International Symposium on Unsteady Aerodynamics, Aeroacoustics, and Aeroelasticity of Turbomachines and Propellers, 6th, University of Notre Dame, IN, Sept. 15-19, 1991) ONERA, TP no. 1991-166, 1991, 15 p. Research supported by SEP and CNES. refs
(ONERA, TP NO. 1991-166)

The supersonic stator-rotor interaction in a simplified turbine stage is simulated by means of a 2D inviscid-flow computation which is carried out on a domain that includes one blade-to-blade passage of the stator and four blade-to-blade passages of the rotor, with a flow periodicity condition imposed on the extreme boundaries of each group. The results indicate that the flow field is highly unsteady and periodic. It is shown that the unsteady effects are very significant on the upper wall of the nozzle, where the shock waves coming from the rotor impinge. Within the rotor, however, the unsteady effects are weak in terms of static pressure fluctuations. I.S.

A92-16139

SOLUTION OF THE COMPRESSIBLE EULER EQUATIONS FOR STEADY FLOWS AROUND HELICOPTER ROTOR BLADES BY AN IMPLICIT SPACE-CENTERED METHOD

J. SIDES and J. C. BONIFACE (ONERA, Chatillon, France) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-27, 1991) ONERA, TP no. 1991-177, 1991, 15 p. Research supported by DRET, EEC, Aerospatiale, et al. refs
(ONERA, TP NO. 1991-177)

An implicit space-centered Euler solver previously developed at ONERA for the calculation of steady transonic flows around airfoils and wings is used here for the numerical simulation of steady compressible flows around helicopter rotor blades. For an extension to the problem of a multibladed rotor in hovering flight, the method is formulated in a rotating frame attached to the blades, using the pseudo-unsteady system of the Euler equations derived by assuming that the total rothalpy is constant. The basic 3D wing code is first applied to the calculation of the steady flow past a wall-mounted half wing with swept tip shape, simulating the transonic flow occurring at the tip of a helicopter rotor blade. Then, preliminary numerical results concerning the two-bladed model rotor of the U.S. Army in hovering flight, and obtained in the framework of a global rotor calculation without wake modeling, are presented and compared with experimental data. Author

A92-16140

AERODYNAMIC AND ACOUSTIC CALCULATIONS OF TRANSONIC NONLIFTING HOVERING ROTORS

J. PRIEUR, M. COSTES (ONERA, Chatillon, France), and J. D. BAEDER (U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) ONERA, TP no. 1991-178, 1991, 30 p. refs
(ONERA, TP NO. 1991-178)

An Euler and a Full Potential Solver are compared for a nonlifting transonic hovering rotor. The correlation is very good on the blade, but the aerodynamic disturbances are damped by the Full Potential Code off the blade tip. The ability of both codes to provide near-field input data for acoustic predictions using Lighthill's Acoustic Analogy is checked. Acoustic results starting from Euler input data show a fairly good correlation with experiment and with direct Euler far-field calculations, even in the case of delocalization. On the contrary,

the precision of the Full Potential results is insufficient for that purpose, and further work is needed to improve the code stability and accuracy off the blade. Author

A92-16141

NUMERICAL OPTIMIZATION OF HELICOPTER ROTOR BLADE AIRFOILS USING UNSTEADY AERODYNAMIC CALCULATIONS [OPTIMISATION NUMERIQUE DE PROFILS DE PALE D'HELICOPTERE PAR DES CALCULS AERODYNAMIQUES INSTATIONNAIRES]

H. BEZARD (ONERA, Chatillon, France) ONERA, TP no. 1991-187, 1991, 27 p. In French. Research supported by DRET. refs
(ONERA, TP NO. 1991-187)

An unsteady potential technique is employed in a numerical optimization process to design new rotor blade airfoils. Wave drag is examined by an unsteady momentum integration and viscous drag by an integral boundary layer method to present a simplified validation on a nonlifting case. Constraints on the mean lift coefficient and the maximum velocity peak on the retreating blade size simulate a high-speed forward flight case. It is shown that the designed airfoils have improved steady and unsteady performance. R.E.P.

A92-18680

NOISE-DRIVEN FLOW

L. HUANG (Cambridge, University, England) Journal of Sound and Vibration (ISSN 0022-460X), vol. 151, Nov. 22, 1991, p. 55-61. Research supported by University of Cambridge. Copyright

The unsteady field induced in a duct by supersonically travelling waves, when analyzed from a 'wave-fixed' co-ordinate system, becomes the problem of supersonic flow over wavy walls. The mean drag on the confined flow due to the waves and its effect on the flow are of interest. It is shown that for a regularly profiled wavy wall the wave strength remains finite according to linear theory at all axial positions; but for the case of a randomly deformed wall the wave energy increases linearly with downstream distance. One can thus deduce that the mean flow would slow down and give up part of its kinetic energy to waves. Equivalently, it is predicted that random supersonic waves would induce strong acoustic streaming in the direction of wave travel. Author

A92-18771

LARGE CHORD TURBINE CASCADE TESTING AT ENGINE MACH AND REYNOLDS NUMBER

D. J. MEE (Oxford, University, England) Experiments in Fluids (ISSN 0723-4864), vol. 12, Dec. 1991, p. 119-124. Research supported by Ministry of Defence Procurement Executive and Rolls-Royce, PLC. refs
Copyright

A technique is presented for producing a flow through a linear cascade of turbine blades of large chord which gives the pressure distribution around a blade the same as that obtained in an infinite cascade for Mach and Reynolds numbers typical of gas turbine operating conditions. Results of experiments with a cascade of three blades of large chord are compared with results from a cascade of nine blades of smaller chord to confirm the validity of the technique. Experiments are performed on the large-chord cascade to examine surface phenomena with high spatial resolution. Boundary layer scales are also increased and profiles on both suction and pressure surfaces of the blade are obtained. Author

A92-20212

INVISID DRAG PREDICTION FOR TRANSONIC TRANSPORT WINGS USING A FULL-POTENTIAL METHOD

J. VAN DER VOOREN and A. J. VAN DER WEES (National Aerospace Laboratory, Amsterdam, Netherlands) Journal of Aircraft (ISSN 0021-8669), vol. 28, Dec. 1991, p. 869-875. Research supported by Netherlands Agency for Aerospace Programs. Previously cited in issue 06, p. 760, Accession no. A90-19926.

refs
Copyright

A92-20218
INCOMPRESSIBLE STEADY AERODYNAMICS USING A STANDARD FINITE ELEMENT CODE

S. DE ROSA and G. PEZZULLO (Centro Italiano Ricerche Aerospaziali, Capua, Italy) *Journal of Aircraft* (ISSN 0021-8669), vol. 28, Dec. 1991, p. 911-913. refs
Copyright

Attention is given to a simple solution of the steady incompressible aerodynamic fields around a body, based on an extension of the conventional approach for scalar fields that uses the standard structural FEM code to lifting flowfields. This approach, which enlists standard preprocessing tools developed for structural problems in the solution of aerodynamic problems, is applicable to general 3D bodies and multicomponent airfoils in virtue of its realization of an unstructured mesh. O.C.

A92-20737
NONEQUILIBRIUM HYPERSONIC INVISCID STEADY FLOWS

M. VALORANI, M. ONOFRI, B. FAVINI, and F. SABETTA (Roma I, Università, Rome, Italy) *AIAA Journal* (ISSN 0001-1452), vol. 30, Jan. 1992, p. 86-93. Previously cited in issue 09, p. 1285, Accession no. A89-25532.
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A92-21318
CONCERNING THE FUNCTIONAL SOLUTION OF TRANSONIC FLOWS [CONTRIBUTION A LA RESOLUTION FONCTIONNELLE D'ECOULEMENTS TRANSSONIQUES]

M. POGU (Ecole Nationale Supérieure de Mécanique, Nantes, France) and G. TOURNEMINE (Rennes I, Université, France) *Revue Roumaine des Sciences Techniques, Serie de Mécanique Appliquée* (ISSN 0035-4074), vol. 36, Sept.-Dec. 1991, p. 405-425. In French. refs

A problem of transonic flow around a profile is considered. The velocity field is the solution of a nonlinear elliptic-hyperbolic problem. In function space an iterative algorithm provides an approximate solution to the problem. This approach also leads to a constructive adjustment procedure of the Kutta-Joukowski condition. L.M.

A92-21504
A BOUNDARY INTEGRAL FORMULATION FOR THE KINETIC FIELD IN AERODYNAMICS. I - MATHEMATICAL ANALYSIS

P. BASSANINI, R. PIVA (Roma I, Università, Rome, Italy), C. M. CASCIOLA (Istituto Nazionale per Studi ed Esperienze di Architettura Navale, Rome, Italy), and M. R. LANCIA (CNR, Istituto per le Applicazioni del Calcolo, Rome, Italy) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 10, no. 6, 1991, p. 605-627. Research supported by MURST. refs
(Contract CNR-89,01214,01; CNR-90,01532,01)
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This paper presents a new boundary integral formulation for the velocity field in aerodynamics, which includes rotational flows with wakes, sources, sinks and vorticity blobs. The velocity field is represented via the Poincaré identity in terms of its divergence, curl, and normal and tangential trace on the boundary. If the first three quantities are supposed to be given, the determination of the velocity field reduces to solving a vector boundary integral equation for the latter. Existence, uniqueness and stability estimates for the solution of this integral equation are proved by a suitable variational method. This kinematical problem is thus well-posed. The formulation here deals explicitly with 3D external flows, but a discussion is also included concerning the different qualitative behavior of 3D and 2D flows. Author

A92-21976
COMPUTATIONAL METHODS IN VISCOUS AERODYNAMICS

T. K. S. MURTHY, ED. and C. A. BREBBIA, ED. (Wessex Institute of Technology, Ashurst, England) *Amsterdam, Netherlands and New York/Southampton, England, Elsevier/Computational*

Mechanics Publications, 1990, 380 p. For individual items see A92-21977 to A92-21987.

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This volume presents papers on the finite volume approach for the Navier-Stokes equations, calculation methods of 3D boundary layers, Navier-Stokes computations for aerodynamic configurations at high angles of attack, and adaptation methods for viscous flows. Also presented are finite element vorticity based methods for the solution of the compressible Navier-Stokes equations, Navier-Stokes code development for transonic flow simulations, a fast viscous correction method for transonic aerodynamics, and 2D incompressible airfoil design and analysis. R.E.P.

A92-22149#
EFFECT OF TURBULENCE MODELING ON DYNAMIC STALL OF A NACA0012 AIRFOIL

MUSTAFA DINDAR and UNVER KAYNAK (Tusas Aerospace Industries, Ankara, Turkey) *AIAA, Aerospace Sciences Meeting and Exhibit*, 30th, Reno, NV, Jan. 6-9, 1992. 15 p. refs
(AIAA PAPER 92-0027) Copyright

The present numerical investigation of the dynamic stall phenomenon gave attention to turbulence-modeling effects, using a Navier-Stokes code for solving the flow field around an airfoil undergoing unsteady harmonic motion. It is established that nonequilibrium effects play an important role in determining the separation and vortex-shedding mechanisms of the dynamic stall regimes; in particular, only the Johnson-King nonequilibrium turbulence model is capable of producing a light-stall hysteresis loop similar to experiment. In the deep stall regime, the same model is found to represent the most realistic features of dynamic stall. O.C.

A92-22446
COMPUTATION OF NORMAL IMPINGING JETS IN CROSS-FLOW AND COMPARISON WITH EXPERIMENT

K. KNOWLES and D. BRAY (Royal Military College of Science, Shrivenham, England) *International Journal for Numerical Methods in Fluids* (ISSN 0271-2091), vol. 13, Dec. 1991, p. 1225-1233. refs

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The PHOENICS code is used to model the flow field surrounding subsonic and underexpanded jets impinging on a ground plane in the presence of a cross-flow, for cases with both a fixed ground plane and a 'rolling road'. The standard K-epsilon turbulence model is used, without correction factors. It is confirmed that this overpredicts the free-jet entrainment rate; the wall-jet spreading rate is slightly underpredicted but the initial thickness is too high. Agreement with experiment is, nevertheless, much better than for previous calculations, showing the importance of the extent of the grid used. The ground vortex formed in cross-flow is shown to move with varying effective velocity ratio and with rolling-road operation in the same manner as experimentally observed. Ground-vortex self-similarity is also accurately predicted with the numerical modeling. Author

A92-23803#
NAVIER-STOKES COMPUTATION OF AIRFOIL IN STALL USING ALGEBRAIC REYNOLDS-STRESS MODEL

LARS DAVIDSON and ARTHUR RIZZI (Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse, France) *AIAA, Aerospace Sciences Meeting and Exhibit*, 30th, Reno, NV, Jan. 6-9, 1992. 12 p. refs
(AIAA PAPER 92-0195) Copyright

Results of a computational study tracing low-speed flow over an airfoil in stall are presented. The mean-flow equations are solved by a code that is a standard explicit Runge-Kutta time-marching cell-centered finite-volume technique using central differencing. Good agreement with the observed stall was obtained after an algebraic Reynolds stress model was implemented. The k and epsilon equations are calculated implicitly using hybrid central/upwind differencing. The resulting discretized linearized equations in both coordinate directions are solved by a tri-diagonal

matrix procedure. The influence of the explicit adding of the fourth-order numerical dissipation in the mean-flow equations is investigated, and it is shown that it has negligible effects on the calculated results. C.A.B.

A92-24426

INFLUENCE OF FLIGHT PARAMETERS ON AIR INTAKE INTERNAL FLOW DISTORTIONS DUE TO GUN BLAST-AIR INTERACTION

J. M. DESSE (ONERA, Institut de Mecanique des Fluides, Lille, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1991, p. 1-10. refs

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A simple experimental setup is presented for measuring the nonsteady distortions due to interaction between an aircraft gun blast and an air intake. This setup has been used in a number of wind tunnels to test the effect of flight parameters under downscale conditions. It is chiefly shown that the results are in good agreement with theoretical estimates: the reinforcement of the blast wave as the flight Mach number increases reduces the compressor inflow distortions. On the basis of our similarity rules, it is concluded that, of those configurations tested, it is when an aircraft is flying at a high altitude, at low Mach and with a low intake mass flow rate, that conditions are least favorable. The nonsteady disturbances at the compressor face plane indicate that the main cause of the engine failure seems to be the simultaneous effects of the sudden, protracted loss of static pressure, combined with the large increases in distortions produced by the many reflected waves inside the air intake. Author

A92-24428

ESTABLISHMENT AND CHARACTERIZATION OF A REPRODUCIBLE VORTEX FOR USE IN STUDYING NONSTEADY TWO-DIMENSIONAL PHENOMENA

J. PEUBE and B. FERRET (Poitiers, Universite, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1991, p. 23-36. refs

(Contract DRET-85-092)

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When studying the nonsteady phenomena of two-dimensional flows, such as in blade-vortex interactions, the main difficulty in experiments is to create a single vortex of a size and circulation that are of the same order as the corresponding quantities far from the blade. An experimental setup is described that produces a vortex by deep dynamic stall of a small airfoil, oscillating in pitch at high speed, under computer control. This vortex has been characterized by flow visualizations and hot-wire anemometry measurements. The objective of creating a single vortex has not been fully achieved, though, since measurements show that the main vortex is preceded by a small one emanating from the trailing edge, and followed by a second structure of opposite circulation. Author

A92-24655

PARAMETRIC AERODYNAMIC DESIGN OF SPINNING FINNED PROJECTILES USING A MATRIX INTERPOLATION METHOD

R. CAYZAC and E. CARETTE (GIAT Industries, Bourges, France) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, Jan.-Feb. 1992, p. 51-56. refs

Copyright

An inexpensive method suitable for numerical parameter studies is introduced. The computational approach has been applied to the preliminary aerodynamic design of high L/D spinning finned projectiles. The influence of several geometric wing parameters on the basic aerodynamic coefficients has been investigated for a supersonic Mach number of 4. Results are provided to achieve the required design rapidly. Finally, some calculations show the precision of the matrix interpolation method. Author

A92-25096

THE USE OF VARIABLE CAMBER TO REDUCE DRAG, WEIGHT AND COSTS OF TRANSPORT AIRCRAFT

J. J. SPILLMAN (Cranfield Institute of Technology, England) (Royal

Aeronautical Society, Lecture, London, England, Dec. 3, 1991) Aeronautical Journal (ISSN 0001-9240), vol. 96, Jan. 1992, p. 1-9. refs

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Ways in which aircraft wings can achieve variable camber are investigated to obtain near optimum conditions over most of the possible flight conditions. It is concluded that variable camber makes it possible to choose the sectional shape of the wing to give minimum profile drag at any cruise flight condition. The variable camber provides direct lift control which accelerates the response to pilot-initiated maneuvers. By dividing the camber flaps into six or more spanwise segments the spanwise distribution of lift can be selected to minimize drag in the cruise, avoid buffet or stalling problems near the wing tips, and reduce wing bending moment in high maneuver or gust conditions. A high level of static pitch stability can be used to maximize gust alleviating response, since rapid changes in incidence are not required for maneuvers. O.G.

A92-25098

A BOUNDARY ELEMENT METHOD FOR THE POTENTIAL, COMPRESSIBLE AERODYNAMICS OF BODIES IN ARBITRARY MOTION

M. GENNARETTI and L. MORINO (Roma I, Universita, Rome, Italy) Aeronautical Journal (ISSN 0001-9240), vol. 96, Jan. 1992, p. 15-19. Research supported by Centro Italiano Ricerche Aerospaziali. refs

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An integral equation and the corresponding boundary-element method are presented for the aerodynamic analysis of compressible, subsonic, potential flows around bodies in arbitrary motion. The formulation has been validated for the case of a hovering rotor. The wake geometry obtained through an incompressible free-wake analysis is used for a prescribed-wake analysis of compressible flows. This procedure gives results which are in good agreement with the experimental data. A comparison with low-Mach-number results shows that the algorithm is capable of correctly predicting the compressibility effects. It is demonstrated that the Prandtl-Glauert-correction procedure overestimates the compressibility effects. O.G.

A92-25735#

THE EVALUATION OF CANARD COUPLINGS AT HIGH ANGLES OF ATTACK

A. J. PONTON, M. V. LOWSON, and R. V. BARRETT (Bristol, University, England) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 20 p. Research supported by Defence Research Agency. refs

(AIAA PAPER 92-0281) Copyright

Experiments have been performed on the vortex flows over a generic canard fighter aircraft model at high angles of attack to identify the conditions under which favorable and unfavorable interferences occur. Favorable canard interactions have been found to be strongly related to canard downwash and to the state of the vortex flows over the main wing. Direct vortex impingement leads to unfavorable interference, though some vortex interactions were found to be advantageous for a limited range of incidence and canard deflection angles. Clear trends in performance with canard mounting position relative to the wing have been found. The optimum canard position is connected with the delivery of the canard downwash onto the wing, and the degree of unfavorable vortex interaction present. Higher canard mounting positions in front and above the main wing are thus preferable. The flow structures observed were highly complex, with interactions between the fuselage, canard, and wing flowfields. The fundamental mechanisms of these vortex flows have been studied. Author

A92-25770#

AN EFFICIENT EULER SOLVER FOR PREDOMINANTLY SUPERSONIC FLOWS WITH EMBEDDED SUBSONIC POCKETS

C. B. ALLEN and S. P. FIDDES (Bristol, University, England) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan.

6-9, 1992. 10 p. refs
(AIAA PAPER 92-0323) Copyright

A hybrid Euler solver is presented that exploits the efficiency of space-marching in supersonic regions of the flow, but reverts to an iterative time-marching scheme if a subsonic region is encountered. Independent time-marching and space-marching schemes are described, along with a simple technique to switch between the two. Particular attention is given to the implementation of boundary conditions in the final method to give a simple scheme which can be applied to any geometry and Mach number. A time-marching scheme is shown based on a first-order discretization with Van-Leer's flux-vector splitting, and a space-marching scheme based on S.F. Wornom's two-point cell-vertex method. Both use line relaxation to solve the resulting finite volume equations. Results are shown for hypersonic intake flow, transonic channel flow, hypersonic channel flow with an embedded subsonic pocket and supersonic blunt body flow. The accuracy and efficiency of the hybrid scheme is clearly demonstrated along with its ease of use.

Author

A92-26356 EXPERIMENTAL AND THEORETICAL STUDIES ON HELICOPTER ROTOR FUSELAGE INTERACTION

N. BETTSCHART, R. HANOTEL, D. ILBAS, and A. DESOPPER (ONERA, Chatillon, France) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-27, 1991) ONERA, TP no. 1991-197, 1991, 14 p. refs
(ONERA, TP NO. 1991-197)

The rotor/fuselage interactional aerodynamics of helicopters are investigated experimentally and analytically. The unsteady velocity field around a scaled helicopter model in forward flight are measured with a three-component laser-Doppler velocimeter. Rotor fuselage calculations are analyzed with an iterative coupling method based on a panel method for the fuselage and a lifting-line code for the rotor. An azimuth marching technique is employed to couple the codes, and it is shown that the laser-Doppler velocimetry techniques can describe the complex configuration including the moving surfaces. The results demonstrate that fuselage effects should be considered to accurately describe the flow characteristics on the inboard part of the rotor disk and to understand the rotor-wake geometry. The experimental results confirm the predictions and conclusions based on the analytical methodology.

C.C.S.

A92-26357 THEORETICAL AND EXPERIMENTAL STUDIES OF HELICOPTER ROTOR/FUSELAGE INTERACTION [ETUDES THEORIQUES ET EXPERIMENTALES DE L'INTERACTION ROTOR/FUSELAGE D'HELICOPTERES]

N. BETTSCHART, R. HANOTEL, D. ILBAS, and A. DESOPPER (ONERA, Chatillon, France) ONERA, TP no. 1991-198, 1991, 20 p. In French. refs
(ONERA, TP NO. 1991-198)

A test was conducted in the ONERA S2 Chalais wind tunnel to measure the unsteady velocity field around a helicopter model in forward flight. Theoretically, an iterative coupling method is developed for rotor fuselage calculations, based on a panel method (source and doublet singularities) for the fuselage and a lifting line code for the rotor. Comparisons show that the fuselage effects must be taken into account, especially for the rotor wake geometry and for the flow conditions on the inboard section of the blade.

R.E.P.

A92-26364 WALL PRESSURE WAVENUMBER-FREQUENCY SPECTRUM BENEATH A TURBULENT BOUNDARY LAYER MEASURED WITH TRANSDUCER ARRAYS CALIBRATED WITH AN ACOUSTICAL METHOD

ERIC MANOHA (ONERA, Chatillon, France) ONERA, TP no. 1991-212, 1991, 16 p. Research sponsored by Service Technique des Constructions et Armes Navales. refs
(ONERA, TP NO. 1991-212)

Wavenumber frequency spectra of the wall pressure field

beneath a turbulent boundary layer have been measured by linear arrays of flush-mounted transducers subjected to the specific technique of two-dimensional space-time Fourier transform. Measurements were made in an anechoic wind facility on a 4 m long, 0.32 m-diameter cylindrical body with free-stream velocities between 10 and 80 m/s. Two streamwise arrays of 32 transducers having different spacing were used. An innovative acoustical method allowed a simultaneous, phase level, and broadband calibration of all the elements of an array. At low frequencies, unaliased wavenumber spectra were obtained, that fit the classical models when plotted in a normalized presentation. At high frequencies, the pressure sensors were not large enough to correctly attenuate the convective region, and the measured low wavenumber levels were probably highly overestimated. Author

A92-26370 AERODYNAMIC COMPUTATIONS OF HIGH-SPEED TRANSONIC PROPELLERS [CALCULS AERODYNAMIQUES DES HELICES RAPIDES TRANSSONIQUES]

P. GARDAREIN (ONERA, Chatillon, France) ONERA, TP no. 1991-218, 1991, 30 p. In French. Research supported by Service Technique des Programmes Aeronautiques. refs
(ONERA, TP NO. 1991-218)

A study of recent research conducted on high-speed counterrotating propfans is presented. For design and parametric analyses a simple curved lifting line method has been used with a more sophisticated technique based on 3D Euler equations (CAPRI code) employed for a fine analysis of the flow field, with emphasis on the blade surface. An outline of the application field of these methods is given by comparing the computed results with experimental data from rotating and counterrotating propellers.

R.E.P.

A92-26381 VALIDATION OF A 3D NAVIER-STOKES CODE ON EXPERIMENTAL COMPRESSOR BLADINGS [VALIDATION D'UN CODE NAVIER-STOKES 3D SUR UNE SOUFFLANTE EXPERIMENTALE]

V. COUAILLIER (ONERA, Chatillon, France), PH. VEYSSEYRE (SNECMA, Centre de Villaroche, Moissy-Cramayel, France), and A. M. VUILLOT (ONERA, Chatillon, France) (European Propulsion Forum 91, Paris, France, Nov. 13-15, 1991) ONERA, TP no. 1991-229, 1991, 19 p. In French. Research supported by DRET. refs

(ONERA, TP NO. 1991-229)

The paper presents a numerical simulation of flow in compressor bladings, and a comparison of the results obtained with those from a series of SNECMA tests. The numerical simulation was performed using a calculation code for solving the averaged Navier-Stokes equations associated with a turbulence model. This code, developed at ONERA, is included in the design chain of compressor blades at SNECMA. The numerical method is characterized by decomposition into subdomains and by a Lax-Wendroff scheme with a finite volume approach discretized on a structured mesh by subdomain.

L.M.

A92-26387 NUMERICAL SIMULATION OF NONREACTIVE FLOWS WITH TRANSVERSE JET USING EULER AND LAMINAR NAVIER-STOKES CODES [SIMULATIONS NUMERIQUES D'ECOULEMENTS NON REACTIFS AVEC JET TRANSVERSAL AU MOYEN DE CODES EULER ET NAVIER-STOKES LAMINAIRE]

M. DORMIEUX (Aerospatiale, Division Engins Tactiques, Chatillon, France), C. JOUET, and M. BORREL (ONERA, Chatillon, France) ONERA, TP no. 1991-237, 1991, 21 p. In French. refs
(ONERA, TP NO. 1991-237)

Missiles utilizing the pyrotechnic lateral force concept are investigated by numerical simulation, where the aerodynamic interaction of the lateral jet on the missile is analyzed. Calculations of this interaction are carried out using Euler and laminar Navier-Stokes codes (FLU3C and FLU3M). The equations that are solved are the unsteady Euler equations for a perfect

one-species gas (FLU3C) or two-species gas (FLU3M), and the laminar unsteady N-S equations for a one-species gas (FLU3M). The codes utilize finite volume methods applied to monodomain structured meshes (FLU3C) and eventually to multidomain meshes (FLU3M). Results are presented for an ONERA model and for the ASTER missile. L.M.

A92-27384

BOUNDARY SINGULARITIES IN STEADY POTENTIAL COMPRESSIBLE FLOW THROUGH PLANE TWO-DIMENSIONAL CHANNELS

C. A. C. STREETER Institution of Mechanical Engineers, Proceedings, Part C - Journal of Mechanical Engineering Science (ISSN 0954-4062), vol. 205, no. C6, 1991, p. 389-398. refs Copyright

The physical and hodograph plane representations of the steady potential flow of a perfect gas through two-dimensional channels are examined with emphasis on the solution of boundary singularities that occur in these flows. Two channel geometries are considered: (1) straight-walled convergent channels of infinite and finite length and (2) finite-length channels with a parallel entry section and a straight-walled convergent exit section. Radial source flow and concave corner flow singularities occurring in the physical plane of subsonic channel flow are removed by expressing the general solution of Chaplygin's stream function equation in hodograph coordinates. A boundary singularity in the hodograph plane is removed by introducing circular polar coordinates. The problem of matching the subsonic and supersonic flow regions at the sonic surface is also analyzed. V.L.

A92-28005

A BOUNDARY INTEGRAL FORMULATION FOR THE KINETIC FIELD IN AERODYNAMICS. II - APPLICATIONS TO UNSTEADY 2D FLOWS

P. BASSANINI (Roma I, Università, Rome, Italy), C. M. CASCIOLA (Istituto Nazionale per Studi ed Esperienze di Architettura Navale, Rome, Italy), M. R. LANCIA (CNR, Istituto per le Applicazioni del Calcolo, Rome, Italy), and R. PIVA (Roma I, Università, Rome, Italy) European Journal of Mechanics, B/Fluids (ISSN 0997-7546), vol. 11, no. 1, 1992, p. 69-92. Research supported by MURST. refs

(Contract CNR-91,01319,01; CNR-90,01532,01)

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The boundary-integral formulation for the velocity field in aerodynamics is investigated in detail in the 2D case. The formulation is purely kinematical and includes rotational flows and potential flows with or without circulation. A scalar boundary-integral equation (derived from the appropriate version of the Poincaré identity for exterior domains) is analyzed and a stability estimate for the (weak) solution is proved. A model for the generation of vorticity for unsteady flows past airfoils is derived from the Euler equations and its relation with the Kutta condition for steady flows is discussed. Numerical results are obtained using collocation and Galerkin techniques for unsteady 2D flows of interest in aerodynamics. Flows past airfoils starting from rest where the circulation and vorticity are determined from the wake model and steady flows with circulation are determined from the Kutta condition. The present approach compares favorably with classical formulations in terms of the velocity potential in the irrotational case. Author

A92-28006

A STUDY OF THE INTERACTION OF A NORMAL SHOCK WAVE WITH A TURBULENT BOUNDARY LAYER AT MACH NUMBERS BETWEEN 1.30 AND 1.55

C. J. ATKIN and C. SQUIRE (Cambridge, University, England) European Journal of Mechanics, B/Fluids (ISSN 0997-7546), vol. 11, no. 1, 1992, p. 93-118. Research supported by SERC. refs Copyright

This paper presents the results of an experimental and numerical investigation of the steady interaction of a normal shock wave with a turbulent boundary layer. The main feature of the experimental work is the use of techniques developed to study

the unsteady interaction to obtain very accurate surface-pressure distributions for the steady interaction. Results are obtained at close intervals in Mach numbers between 1.30 and 1.55. Holographic interferometric photographs and spark shadowgraph photographs of the flow are presented at all the test Mach numbers. Density contours from these numerical solutions are compared with the interference fringes, and the best turbulence models are then used to examine physical features of the interaction. The combined experimental and numerical results are used to develop a complete description of the flow development from attached flow at $M = 1.30$ to fully separated flow at $M = 1.55$. Author

A92-28523* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

NAVIER-STOKES SOLUTION OF TRANSONIC CASCADE FLOWS USING NONPERIODIC C-TYPE GRIDS

ANDREA ARNONE (Firenze, Università, Florence, Italy), MENG-SING LIOU, and LOUIS A. POVINELLI (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Mar.-Apr. 1992, p. 410-417. Previously announced in STAR as N91-11192. refs

Copyright

A new kind of C-type grid is proposed, this grid is non-periodic on the wake and allows minimum skewness for cascades with high turning and large camber. Reynolds-averaged Navier-Stokes equations are solved on this type of grid using a finite volume discretization and a full multigrid method which uses Runge-Kutta stepping as the driving scheme. The Baldwin-Lomax eddy-viscosity model is used for turbulence closure. A detailed numerical study is proposed for a highly loaded transonic blade. A grid independence analysis is presented in terms of pressure distribution, exit flow angles, and loss coefficient. Comparison with experiments clearly demonstrates the capability of the proposed procedure. Author

A92-28975

DETERMINATION OF THE AERODYNAMIC FLOW ABOUT A REENTRY BODY AT HIGH ALTITUDE [DETERMINATION DE L'ÉCOULEMENT AÉRODYNAMIQUE AUTOUR D'UN CORPS DE RENTRÉE A HAUTE ALTITUDE]

J. COUZI, B. DUBROCA, and G. GALLICE (CEA, Direction des Applications Militaires, Le Barp, France) Revue Scientifique et Technique de la Défense (ISSN 0994-1541), 4th Quarter, 1991, p. 111-122. In French. refs

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A numerical simulation of atmospheric hypersonic reentry is developed to describe the thermodynamic characteristics of the phenomenon, with the aim of obtaining the radar and optical signatures. The physicochemical parameters of nonequilibrium thermodynamic flow are discussed with reference to the laws of chemical-reaction kinetics, gas-wall interaction, and gas physics. The Navier-Stokes equations for nonequilibrium are presented, and relations are established for the thermodynamics of diffusion with attention given to limiting conditions at the surfaces. The equations are solved for the diffusion and convection terms, and an implicit linearization scheme is developed. Graphs are presented which demonstrate the concentrations of molecular oxygen and the pressure distribution about the body upon reentry, and the results are compared with available experimental data. It is shown that the numerical treatment can be used in conjunction with experimental data to describe the radar and optical characteristics of hypersonic reentry flows. C.C.S.

A92-30000

GENERALIZED EXPRESSION OF CHOROCHRONIC PERIODICITY IN TURBOMACHINERY BLADE-ROW INTERACTION

G. A. GEROLYMOS and V. CHAPIN (Paris VI, Université, Paris, France) La Recherche Aérospatiale (English Edition) (ISSN 0379-380X), no. 5, 1991, p. 69-73. refs

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The unsteady flow which is generated when 2 turbomachinery blade-rows are in relative angular motion is periodic in time, with

a different period in the frame of reference associated with each blade row, and is characterized by a pitchwise traveling wave chorochronic periodicity. This periodicity is studied for arbitrary angular velocities and pitch-ratio of the 2 blade-row and simple formulas for the corresponding interblade-phase angles are given.

Author

A92-31188

CYLINDER-INDUCED SHOCK-WAVE BOUNDARY-LAYER INTERACTION

OKTAY OZCAN and BULENT K. YUCEIL (Istanbul Technical University, Turkey) AIAA Journal (ISSN 0001-1452), vol. 30, April 1992, p. 1130-1132. Research supported by Istanbul Technical University. refs

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The shock-wave/turbulent boundary-layer interaction generated by a cylindrical protuberance mounted on a flat plate was investigated in a trisonic wind tunnel, at Mach numbers 1.7 and 2.2, using oil flow visualization technique to observe flow characteristics. Data are presented for flow regions both upstream and downstream of the cylinder, demonstrating various physical aspects of the flow, including the static pressure contours and the skin-friction lines on the flat plate. I.S.

A92-31496

SIMULATION OF HYPERSONIC FLOWS ON UNSTRUCTURED GRIDS

V. SELMIN and L. FORMAGGIA (Alenia S.p.A., Turin, Italy) (International Association for Computational Mechanics, World Congress of Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 34, March 30, 1992, p. 569-606. Previously announced in STAR as N91-30102. refs

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The study of high speed flows is receiving attention by aerospace industries in connection with the design of high supersonic transport aircrafts and reentry vehicles. The development of effective numerical solvers is of particular interest due to the difficulties and high costs associated with experimental work at this flow regime. High speed flow is characterized by the importance of forms of energy which are normally neglected at lower speed, namely the excitation of vibrational degrees of freedom, dissociation and ionization. The solution algorithm must take into account, to some degree, all or some of these mechanisms of energy transfer. In addition, the flow solution normally presents strong shocks and shock interactions. The code must be able to capture those features without spurious oscillations. Simulation systems taking all these factors into consideration are presented. Author

A92-32323

THE SECOND GOLDSTEIN LECTURE: MODERN DEVELOPMENTS IN FLUID DYNAMICS - AN ADDENDUM

J. E. GREEN (Aircraft Research Association, Bedford, England) Aeronautical Journal (ISSN 0001-9240), vol. 96, March 1992, p. 69-86. refs

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A development history of wind tunnel test apparatus design and operation is presented, with a view to the characterization of state-of-the-art facilities and the currently critical wind tunnel factor of operational Reynolds number approximation. Attention is given to the fluid dynamics bases for scale effects. Two new aircraft categories, natural laminar flow designs and very large transonic transports, are identified as subject to more pronounced tunnel-to-flight scale effect than current aircraft; countermeasures applicable to these aircraft types are proposed. The nature of a fluid dynamic phenomenon associated with the loss of measurements-reproducibility is discussed. O.C.

A92-36021

THE EFFECTS OF WALL SUCTION ON LAMINAR-TURBULENT TRANSITION IN THREE-DIMENSIONAL FLOW

D. ARNAL, J. C. JUILLEN, and G. CASALIS (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 155-162. refs

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This paper is devoted to an experimental theoretical study of the wall suction effects on transition in three-dimensional flow. The experiments are performed on an 'infinite' swept wing placed in a subsonic wind tunnel. The movement of the transition onset is measured for different wind tunnel speeds and different suction rates. Typical boundary layer profiles are also presented. The prediction of the transition location is made by using empirical criteria and the n method. The n factor is computed from the spatial theory with a strategy developed at ONERA/CERT. It is shown that a fairly acceptable agreement is obtained with a constant value of the n factor, even if the computations overestimate the transition location in some cases. The measurements are also compared with other stability results obtained with different codes. Author

A92-36029

ARBITRARY BLADE SECTION DESIGN BASED ON VISCOUS CONSIDERATIONS - BACKGROUND INFORMATION

B. BOURAS, F. KARAGIANNIS, G. LEOUTSAKOS, K. GIANNAKOGLU, and K. D. PAPAILIOU (Athens, National Technical University, Greece) IN: Numerical simulations in turbomachinery; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 1-14. refs

(Contract EEC-EN3W-0035-GR)

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Background information is presented on an arbitrary blade section design method is presented. The method itself is outlined in a joint paper. This information concerns the assumptions, the development, and the predictive capabilities of the viscous flow calculation tool used in the design procedure. The prediction of the design and off design performance of an arbitrary cascade is discussed as well. Finally, the general properties of the laminar and turbulent unseparated or separated compressible shear layers necessary for the blade optimization procedure are established. Author

A92-36830

EXPERIMENTAL INVESTIGATION OF SUPERSONIC FLOW OVER TWO CAVITIES IN TANDEM

XIN ZHANG and JOHN A. EDWARDS (Cambridge, University, England) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1182-1190. Research supported by Ministry of Defence Procurement Executive of England. Previously cited in issue 21, p. 3289, Accession no. A90-45901. refs

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A92-36839

ASYMPTOTIC DEFECT BOUNDARY-LAYER THEORY APPLIED TO HYPERSONIC FLOWS

B. AUPOIX, J. PH. BRAZIER, and J. COUSTEIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1252-1259. refs

Copyright

For hypersonic re-entry flows, the bow shock wave upstream of the spacecraft is the cause of an inviscid vortical flow in the shock layer. Prandtl's equations are unable to cope with outer flow vorticity, whereas Van Dyke's matched asymptotic expansions approach no longer gives a good matching of the viscous and inviscid solutions when the boundary layer is thick. A new approach, using a defect formulation in the viscous region together with a matched asymptotic expansions technique, has been developed. The so-derived equations are consistent with Prandtl's or Van Dyke's equations. Fair predictions are achieved for incompressible flows with external vorticity only with second-order solutions

because displacement effects have to be accounted for, whereas for hypersonic flows where displacement effects are weak, a good agreement with Navier-Stokes solutions is obtained with a first-order approach. Author

A92-37539* National Aeronautics and Space Administration, Washington, DC.

THE COMPUTATION OF THREE-DIMENSIONAL FLOWS USING UNSTRUCTURED GRIDS

K. MORGAN, J. PERAIRE, J. PEIRO (Imperial College of Science, Technology, and Medicine, London, England), and O. HASSAN (Swansea, University College, Wales) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 87, no. 2-3, June 1991, p. 335-352. refs (Contract NAGW-1809)

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A general method is described for automatically discretizing, into unstructured assemblies of tetrahedra, the three-dimensional solution domains of complex shape which are of interest in practical computational aerodynamics. An algorithm for the solution of the compressible Euler equations which can be implemented on such general unstructured tetrahedral grids is described. This is an explicit cell-vertex scheme which follows a general Taylor-Galerkin philosophy. The approach is employed to compute a transonic inviscid flow over a standard wing and the results are shown to compare favorably with experimental observations. As a more practical demonstration, the method is then applied to the analysis of inviscid flow over a complete modern fighter configuration. The effect of using mesh adaptivity is illustrated when the method is applied to the solution of high speed flow in an engine inlet.

Author

A92-37551

NON-EQUILIBRIUM HYPERSONIC FLOW SIMULATIONS USING THE SECOND-ORDER BOUNDARY LAYER EQUATIONS

M. L. SAWLEY and S. WUETHRICH (Lausanne, Ecole Polytechnique Federale, Switzerland) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 129-140. Research supported by Dassault Aviation and Commission Suisse pour l'Encouragement de la Recherche Scientifique. refs

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A coupled Euler/boundary layer method to calculate hypersonic reentry flows in chemical nonequilibrium is described. The flow is divided into two regions, with the second-order boundary layer equations being applied in the inner (viscous) region and the Euler equations in the outer (inviscid) region. It is shown that this allows a good matching of the calculated profiles at the interface between the two regions. The inclusion of second-order effects is shown not only to modify significantly the calculated boundary layer profiles, but also to have a large influence on the computed surface coefficients.

Author

A92-37553

PERFORMANCE OF TURBULENCE MODELS TO PREDICT SUPERSONIC BOUNDARY LAYER FLOWS

F. HANINE and A. KOURTA (Toulouse, Institut de Mecanique des Fluides, France) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 221-235. refs

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The predictions of near-wall compressible flows with turbulence models are evaluated by means of a test case with attention given to the impact of the compressibility effect. The k-omega-squared model by Wilcox and Rubesin (1980) is examined because of its applicability to compressible flows, and the model

is compared to k-epsilon models that do not account for compressibility. Another version of the second-order model is employed to analyze the behavior of the anisotropy near the wall under the compressibility effects. The second-order and the Wilcox-Rubesin model are shown to perform better than the first-order models for the calculation of the supersonic flat-plate boundary layer. The results are further improved by using a correction by Nichols (1990) and a compressibility correction by Vandromme (1983) in the formulation of the model by Chien (1982). The results demonstrate that compressibility does not significantly modify the principal characteristics of boundary-layer flows.

C.C.S.

A92-37554

AN INFORMATION SYSTEM FOR THE NUMERICAL SIMULATION OF 3D EULER FLOWS AROUND AIRCRAFT

J. W. BOERSTOEL and S. P. SPEKREYSE (National Aerospace Laboratory, Amsterdam, Netherlands) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 237-257. refs

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A flow-simulation system is described with attention given to its application to the study of complex 3D aerodynamic configurations using multiblock-grid generation. The numerical flow-simulation system is based on five subtasks: block subdivision, grid generation, numerical flow simulation, graphical inspection, and method managing. The grid-generation function is described generically for constructing the multiblock grid emphasizing block decomposition, the ability to treat compound edges and faces, and the use of parametric functions for face-surface geometries. Transfinite interpolation is used to develop a grid-generation method for block faces, and the Dirichlet/Neumann boundary-value problem for grid-control functions can be treated without grid folding. The fundamental mathematical algorithm and the methods for multiblock-grid generation are expected to provide accurate simulations of flows about aircraft.

C.C.S.

A92-37933

A NOTE ON THE KUTTA CONDITION IN GLAUERT'S SOLUTION OF THE THIN AEROFOIL PROBLEM

S. W. RIENSTRA (Eindhoven University of Technology, Netherlands) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 26, no. 1, Feb. 1992, p. 61-69. refs

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Glauert's classical solution of the thin aerofoil problem (a coordinate transformation, and splitting the solution into a sum of a singular part and an assumed regular part written as a Fourier sine series) is usually presented in textbooks on aerodynamics without a great deal of attention being paid to the role of the Kutta condition. Sometimes the solution is merely stated, apparently satisfying the Kutta condition automatically. Quite often, however, it is misleadingly suggested that it is by the choice of a sine series that the Kutta condition is satisfied. It is shown here that if Glauert's approach is interpreted in the context of generalized functions: (1) the whole solution, i.e., both the singular part and any non-Kutta condition solution, can be written as a sine series; and (2) it is really the coordinate transformation which compels the Kutta condition to be satisfied, as it enhances the edge singularities from integrable to nonintegrable, and so sifts out solutions not normally representable by a Fourier series. Furthermore, the present method provides a very direct way to construct other, more singular solutions. A practical consequence is that (at least, in principle) in numerical solutions based on Glauert's method, more is needed for the Kutta condition than a sine series expansion.

Author

A92-38858

FLOW REGIMES OF THE COVE REGIONS BETWEEN A SLAT AND WING AND BETWEEN A WING AND FLAP OF A MULTIELEMENT AIRFOIL

E. SAVORY, N. TOY, B. TAHOURI, and S. DALLEY (Surrey,

University, Guildford, England) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 307-316. Research supported by SERC. refs

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An experimental study was made of the flow regimes associated with the cove regions of a multielement airfoil. These regions occur when the leading edge slats and trailing edge flaps on the wings are extended to generate high lift during takeoff and landing of the aircraft. The results include mean velocity and turbulence intensity data, measured between the slat and wing and between the wing and flap, together with comprehensive pressure distributions around the three airfoil components. This information should be of value in the development of numerical models for predicting the flow around high-lift airfoils. Author

A92-38861

REYNOLDS STRESS DISTRIBUTION DOWNSTREAM OF A TURBINE CASCADE

ANTONIO PERDICHIZZI (Brescia, Università, Italy), MARINA UBALDI, and PIETRO ZUNINO (Genova, Università, Genova, Italy) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 338-350. refs

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Results of an experimental investigation of three-dimensional turbulent flow developing downstream of a turbine cascade (aspect ratio, 1.05; flow turning, 84 deg) are reported for four planes located respectively at 10, 30, 54, and 90 percent of an axial chord downstream of the blade trailing edge. The main features of the mean flowfield evolution are the mixing process occurring in the wake, mutual interaction of the secondary vortices, and the decay of the secondary kinetic energy. The Reynolds stress distributions are found to be consistent with the complicated nature of the mean motion. V.L.

A92-39427

BASE BLEED TECHNOLOGY IN PERSPECTIVE

G. V. BULL (Space Research Corp., Brussels, Belgium) IN: Base bleed. New York, Hemisphere Publishing Corp., 1991, p. 1-16. refs

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The general fluid mechanic mechanism for flow about axisymmetric bodies (shell shapes) is reviewed, with reference to the very early experimental work (circa 1900) which resulted in determination over the subsonic-supersonic range of the drag-Mach number relationship. A numerical example of drag component values for one type of modern shell is presented, to illustrate the major significance of the base drag component. The long range 210 mm Paris gun shell of 1918 is discussed, being of interest as perhaps, an outer bound to the envelope of shell trajectories (apogee: 43 km, range 127 km). The history of base injection studies is sketched briefly through early post-war work to the present systems. Various postulated wake flow models are discussed. Firing results for the minimum drag forebody projectile (commonly known as the ERFB projectile) are presented showing range increase with base bleed in the order of 30 percent. Author

A92-39433

COMPUTER CODES FOR BALLISTIC PERFORMANCE CALCULATIONS OF BASE BLEED PROPELLANT GRAIN

YVES FABIGNON (SNPE, Centre de Recherches du Bouchet, Vert-le-Petit, France) and DOMINIQUE COUPEZ (SNPE, Saint-Médard-en-Jalles, France) IN: Base bleed. New York, Hemisphere Publishing Corp., 1991, p. 107-124. refs

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Two computer codes are presently developed in order to investigate the effectiveness of base-bleed systems; it is anticipated that the programs' intensive use will allow preliminary base-bleed

propellant grain design studies to be quickly performed. Calculations have been conducted to either analyze tendencies or compare results for various base-bleed configurations in view of their injected mass-flow rate or combustion gas composition. Pressure ratio results show comparable performance for the two methods. O.C.

A92-39940

PANEL METHOD CONTROL IN 3-D HYPERBOLIC GRID GENERATION

M. H. L. HOUNJET (National Aerospace Laboratory, Amsterdam, Netherlands) (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaíso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S121-S129. Research supported by Netherlands Agency for Aerospace Programs. refs

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A method is presented for the generation of OH type grids about transport type aircraft. The method combines a hyperbolic grid generation scheme with source terms obtained with a panel method in such a way that OH type grids around fairly complex shapes with concavities can be generated easily. The components of the method: a method to generate grids with a panel method and the hyperbolic grid generation scheme, will be described and applications will be shown. Author

A92-40055

BURSTS AND SOURCES OF PRESSURE FLUCTUATION IN TURBULENT BOUNDARY LAYERS

J. F. MORRISON (GEC Alsthom Turbine Generators, Ltd., Aerodynamics Group, Manchester, England) and P. BRADSHAW (Stanford University, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 2-1-1 to 2-1-6. Research supported by U.S. Army. refs

A four-wire array in a flat-plate, zero-pressure-gradient turbulent boundary layer is used to make low-wave-number measurements of the spanwise components of the quantities which appear as source terms in Poisson's equation for the pressure fluctuation. These source terms, referred to as 'splat' and 'spin', are analyzed by use of the VITA-LEVEL conditional sampling scheme and the results are correlated with the local wall pressure. The results show that the period between successive ejections and sweeps, and the period between successive splats and/or spins both scale with viscous variables (not with wall variables), suggesting that high-wave-number pressure fluctuations trigger the bursting sequence. Author

A92-40081

TURBULENT ENERGY BUDGETS IN IMPINGING ZONES

J. M. M. BARATA, D. F. G. DURAO, and M. V. HEITOR (Lisboa, Universidade Técnica, Lisbon, Portugal) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 8-3-1 to 8-3-6. Abridged.

The study presents budgets of turbulent kinetic energy in the vicinity of the stagnation zone created by the impingement of a turbulent jet on a flat plate through a low-velocity crossflow. The analysis is based on laser-Doppler measurements of the time-resolved velocity field, which were carried out for a velocity ratio between the jet and the crossflow of 30, for a Reynolds number based on the jet exit conditions of 60,000 and for an impinging distance of 5 jet-diameters, and provide a basis for a better understanding of several related but more complex practical flowfields. The results quantify the time-averaged vortex structure developed in this type of flows, as well as the decrease of the Reynolds stresses in the region of strong (stabilizing) curvature, which characterizes the impinging zone, followed by their fast increase before finally decreasing. The nature of the turbulent transport of Reynolds stresses is analyzed, and the related

implications for the calculation of complex turbulent flows is discussed. C.A.B.

A92-40125

TRANSITION TO TURBULENCE IN CURVED CHANNEL FLOW

O. J. E. MATSSON (Royal Institute of Technology, Stockholm, Sweden), ALESSANDRO BOTTARO (Lausanne, Ecole Polytechnique Federale, Switzerland), and P. H. ALFREDSSON (Royal Institute of Technology, Stockholm, Sweden) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-2-1 to 18-2-6. Research supported by STU. refs

Experiments and numerical simulations have been carried out for the developing flow in a curved channel. This flow is susceptible to a centrifugal instability, which results in the formation of streamwise oriented vortices. Linear stability theory is able to accurately predict the critical Reynolds number, i.e., the Reynolds number for which the primary instability starts to develop. If the Reynolds number is increased above the critical a number of supercritical bifurcations occurs before a developed turbulent state is reached. The focus here is on the initial stages of transition to turbulence of the flow from its original laminar state. Our measurements and simulations show that even at Reynolds numbers six times the critical one the longitudinal vortex structure persists. Author

A92-40127

INFLUENCE OF SUCTION THROUGH A SLOT ON A TURBULENT BOUNDARY LAYER

G. PAILHAS, J. COUSTEIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France), F. ANSELMET, and L. FULACHIER (Institut de Mecanique Statistique de la Turbulence, Marseille, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-4-1 to 18-4-6. refs

The goal of the study is to analyze the effects of slot suction on a turbulent boundary layer and the relaxation of the flow downstream of the slots. The present study is also devoted to the understanding of the bursting phenomenon occurring in a boundary layer the turbulence of which is manipulated by localized suction. Two experiments are presented. One of them, in a water tunnel, is concerned with visualizations and measurements of mainly mean velocity with laser Doppler anemometry. The other one is carried out in a wind tunnel, by means of hot wire anemometry, with one or several slots, in order to mostly determine the influence of suction on velocity fluctuations and their correlation. A spectral analysis has also been made. In order to educe the general effect of suction on the coherent structures, a conditional analysis has been performed. Author

A92-40128

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF A TURBULENT BOUNDARY LAYER OVER RIBLETS

M. BENHALILOU, F. ANSELMET, J. LIANDRAT, and L. FULACHIER (Institut de Mecanique Statistique de la Turbulence, Marseille, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-5-1 to 18-5-6. Research supported by Service Technique des Programmes Aeronautiques. refs

The effect of triangular riblets on a turbulent boundary layer is investigated both experimentally and numerically. Measurements are performed in a water tunnel with laser-Doppler velocimetry extending within the grooves: mean values and Reynolds stresses relative to the longitudinal and spanwise velocity components are presented. Numerical predictions, assuming that the mean spanwise velocity is zero, are developed with a mixing length model. Author

A92-40140

COMPRESSIBILITY EFFECTS IN TURBULENT FAR WAKES

J. P. BONNET, J. DELVILLE, S. SAPIN (Poitiers, Universite, France), P. SULLIVAN (Clarkson University, Potsdam, NY), and R. YERU (Poitiers, Universite, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-1-1 to 23-1-6. Research supported by CNRS and NSF. refs

An experimental investigation of the Mach number effects in two-dimensional far wakes is presented. Three regimes are studied: subsonic (Mach 0.1), Mach 2.0 and Mach 4.2, in the developed part of the initially turbulent wakes. Hot wire anemometry is used to give one point statistics and conventional space-time correlations (STC). It is shown that, like in boundary layers, the intermittent part of the wakes are of less transversal extent in the supersonic cases. The spectra are strongly modified in the vicinity of the axis. The scales and the shapes of the STC are also quite sensitive to the Mach number. The supersonic wake seems to be more strongly structured than the equivalent subsonic one, with slight differences between Mach 2 and 4. Author

A92-40143

THE EFFECTS OF VISCOSITY AND DIFFUSION ON A SUPERSONIC MIXING LAYER

P. VUILLERMOZ (SEP, Vernon, France) and E. S. ORAN (U.S. Navy, Naval Research Laboratory, Washington, DC) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-4-1 to 23-4-6. Research supported by U.S. Navy and SEP. refs

Time-dependent two-dimensional numerical simulations of high-speed, compressible, confined, temporally evolving supersonic mixing layers between hydrogen and oxygen gas streams are used to examine the differences between Euler and Navier-Stokes solutions and the effects of convective Mach number. The computations show that the Euler solutions are reasonably accurate in the convective-mixing stage of the flow, when large-scale structures dominate. As the convective Mach number increases, the mixing and turbulent levels are reduced. Author

A92-40549

RECENT RESEARCH INTO THE AERODYNAMICS OF ASTOVL AIRCRAFT IN GROUND ENVIRONMENT

K. KNOWLES and D. BRAY (Royal Military College of Science, Shrivenham, England) (Royal Aeronautical Society, AeroTech 92, Seminar, Birmingham, England, Jan. 14-17, 1992) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 123-131. Research supported by British Aerospace, PLC. refs Copyright

Some of the aerodynamic phenomena associated with jet-lift aircraft in ground effect are discussed, with particular attention paid to current studies on ASTOVL aircraft. The problems associated with jet-lift aircraft in ground effect (airframe airloads, ground erosion, ground crew safety, noise, and airframe acoustic fatigue) are related to a number of jet-flow phenomena which are briefly outlined. The problem of hot-gas-ingestion avoidance by the engine is examined. The particular problems of modelling the ground vortex formed by impinging jets in cross-flows are then described in light of the authors' experimental studies. Finally, the importance of the stochastic behavior of hot-gas-ingestion-related flow fields is highlighted. S.A.V.

A92-40600

NUMERICAL PREDICTIONS OF TRANSONIC VISCOUS FLOWS AROUND AEROFOILS THROUGH AN EULER/BOUNDARY LAYER INTERACTION METHOD

D. P. COIRO, M. AMATO, and P. DE MATTEIS (Centro Italiano Ricerche Aerospaziali, Capua, Italy) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 954, April 1992, p. 157-165. refs Copyright

A semiinverse viscous/inviscid coupling technique for the calculation of compressible flows is presented. Euler equations in integral form are solved for the inviscid part and integral

compressible boundary-layer equations in direct and inverse form are solved for the viscous one. Interaction is realized using the equivalent sources approach. The technique has been applied to the calculation of the aerodynamic characteristics of aerofoils both in cruise and take-off or landing configurations. To treat the complex geometries involved in the latter case, a multiblock approach, based on structured 'H' grid topology, has been developed and validated for different configurations. Author

A92-41289

EXTRAPOLATION PROCEDURES FOR THE TIME-DEPENDENT NAVIER-STOKES EQUATIONS

JAN NORDSTROM (Aeronautical Research Institute of Sweden, Bromma) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1654-1656. Previously cited in issue 17, p. 2851, Accession no. A91-40777. refs
Copyright

A92-41545

BASIC EXPERIMENT ON A SUPERSONIC VORTEX FLOW AROUND A MISSILE BODY

DIDIER PAGAN, PASCAL MOLTON, and JEAN DELERY (ONERA, Chatillon, France) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 373-378. Research supported by DRET. Previously cited in issue 06, p. 797, Accession no. A91-19220. refs
Copyright

A92-41817

MODELS OF TURBULENCE IN A HYPERSONIC BOUNDARY LAYER [MODELES DE TURBULENCE EN COUCHE LIMITE HYPERSONIQUE]

B. AUPOIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 71-88. In French. refs
Copyright

Various aspects of the application of turbulence models to hypersonic flows are examined, with particular attention given to boundary layer flows. Various turbulence models, the turbulence transport equations used in these models, and modifications introduced to account for compressibility effects are investigated. Consideration is then given to the application of turbulence models to the prediction of a high-Mach-number zero-pressure-gradient boundary layer and a strongly decelerated and then accelerated boundary layer. These examples indicate the key problems encountered in hypersonic turbulence modeling. Finally, a novel two-layer model currently under development at ONERA/CERT is discussed. L.M.

A92-42124

SECONDARY FLOW INVESTIGATION INSIDE THE PASSAGE OF A COMPRESSOR CASCADE

A. SALAM (Brussel, Vrije Universiteit, Brussels, Belgium) and M. Q. ISLAM (Bangladesh University of Engineering and Technology, Dhaka) Institution of Engineers (India), Journal, Mechanical Engineering Division (ISSN 0020-3408), vol. 72, pt. MC 1, May 1991, p. 11-18. refs
Copyright

In this paper a carefully planned experimental investigation of secondary flowfield inside the passage of a compressor cascade is presented. An on-frame experimental setup with an advanced data acquisition facility was utilized. A rotating slanted hot wire measurement technique was applied to determine the magnitude and direction of the velocity of the flow in the space. An existing two-dimensional processing code which read the periodic averaged data and processed them to obtain a two-dimensional flow structure was modified and made usable for the three-dimensional flowfield. Spanwise variation of pitch averaged outlet flow angles was checked by the Horlock's simplified inviscid secondary flow theory. Generally, there was a fair agreement between the theory and experiment. The trailing vortices were detected experimentally at

some distance away from the trailing edge. The sense of these vortices were found to be opposite to that of the passage vortices which was in agreement with the theory. Author

A92-43055

CALCULATION OF THREE-DIMENSIONAL TURBULENT FLOW IN WIND TUNNEL ENTRY SECTION [BERECHNUNG DER DREIDIMENSIONALEN TURBULENTEN STROEMUNG IN WINDKANALVORSTRECKEN]

W. MEILE and W. GRETHER (Graz, Technische Universitaet, Austria) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 303-T 305. In German. refs
Copyright

A numerical simulation of the flow in the entry sections of boundary layer wind tunnels is presented. Surface roughnesses and appropriate combinations of tunnel entry sections were determined in order to create and maintain a velocity profile up to the measuring section. C.D.

A92-43071

UPWIND SCHEMES FOR NAVIER-STOKES COMPUTATIONS AT SUBSONIC THROUGH HYPERSONIC SPEEDS

D. DRIKAKIS and S. TSANGARIS (Athens, University, Greece) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 385-T 388. refs
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Improvements of the Flux Vector Splitting method for solving the Euler equations are proposed. One modification involves defining the inviscid fluxes on cell faces instead of on the center of the volume. The second modification involves splitting the eigenvalues and improving results in the sonic point region. Finally, the improvement of the FVS method is completed by a hybrid five-point extrapolation scheme for calculating conservative variables on the cell faces. C.D.

A92-43167

COMPUTER SIMULATION OF AN UNSTEADY FLOW AROUND AN AIRFOIL WITH A SPOILER

C. R. KAYKAYOGLU and KEMAL KAYA (Istanbul Technical University, Turkey) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 330-333. refs

The scope of this computer simulation is to study the unsteady flow past an airfoil which is perturbed by a full span plain type spoiler protruding from the upper surfaces. Numerical simulation is based on the combined discrete-vorticity and auxiliary-source point methods, which is an innovative grid-free approach to study separated flows. Both unsteady wake development and surface pressure distributions are revealed. The new method is developed not only to represent the vortex shedding in the near wake but also to simulate the interaction between the body and its wake without the need for a transformation. The periodic shedding of vortices from two separation points continues as the flow progresses. The computer flow visualization via velocity vectors and the point vortices shows the details of different flow mechanisms. The present computational predictions are in agreement with experimental results. Author

A92-43447

AN EXPERIMENTAL INVESTIGATION OF THE OBLIQUE BLADE-VORTEX INTERACTION

M. B. HORNER, E. SALIVERO, and R. A. MCD. GALBRAITH (Glasgow, University, Scotland) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-26, 1991) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 955, May 1992, p. 184-191. Research supported by Ministry of Defence of England and Royal Aerospace Establishment. refs
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02 AERODYNAMICS

Improvements in the Glasgow University blade-vortex interaction (BVI) wind tunnel facility, as well as in the data-reduction methods applied, are reflected in the quality of the present BVI experimental investigation results. These data are noted to be both qualitatively and quantitatively similar to those collected in corresponding parallel interactions, where said interactions are within ± 30 deg of parallel. Attention is given to the effects of 3D interactions which are not accounted for in the nondimensionalization conventionally used in the analysis of parallel blade-vortex interactions. O.C.

A92-45318

PREDICTION AND MEASUREMENT OF JET FLOWFIELD FEATURES FOR ASTOVL AIRCRAFT

J. MCGUIRK, G. J. PAGE, N. SAKELLARIOU (Imperial College of Science, Technology, and Medicine, London, England), J. E. FLITCROFT, W. ABBOTT, D. R. WHITE (Royal Aerospace Establishment, Pyestock, England), and P. TATTERSALL (Royal Aerospace Establishment, Farnborough, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.6.1-III.6.9. Research supported by Ministry of Defence Procurement Executive. refs

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Results from a program of experimental and theoretical research on ASTOVL jet flows are presented. The experimental investigations explore how the supersonic exhaust jet velocities on ASTOVL aircraft affect features of the jet flowfield during landing. The implications for the viability of modeling techniques used to assess the severity of hot-gas ingestion behavior are examined. Flowfield measurements are presented for the ground plane and interjet fountain produced by twin impinging jets, at nozzle pressure ratios up to 4:1. Inlet temperature rise characteristics observed using a two-poster simplified aircraft configuration model, operating with jet conditions up to full ASTOVL powerplant pressures and temperatures, are also discussed. Progress with the development of a transonic flow version is described and demonstrated by comparisons with measurements from the experimental work.

C.A.B.

A92-45324

THE EXPERIMENTAL AND COMPUTATIONAL STUDY OF JET IMPINGEMENT FLOWFIELDS WITH REFERENCE TO VSTOL AIRCRAFT PERFORMANCE

A. G. SMITH (S & C Thermofluids, Ltd., Kelston, England), D. N. ING, and P. J. BAILEY (Logico Systems, Ltd., East Horsley, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.13.1-III.13.15. refs

Copyright

Je flowfields generated by ASTOVL aircraft in ground effect have been studied experimentally and computationally. The general aspects of single-, twin- and three-jet impingement are described via experimental information obtained using laser sheet and schlieren photography as well as ground and underfuselage surface pressure measurements. The implications for ASTOVL aircraft performance are discussed. The results obtained by the use of two general purpose computational fluid dynamic packages for the prediction of such flowfields are presented and the design capability explored. Author

A92-45477#

NUMERICAL INVESTIGATION INTO HIGH-ANGLE-OF-ATTACK LEADING-EDGE VORTEX FLOW

J. I. VAN DEN BERG, H. W. M. HOEIJMAKERS, and H. A. SYTSMAN (National Aerospace Laboratory, Amsterdam, Netherlands) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1-11. Research supported by Netherlands Agency for Aerospace Programs. refs (AIAA PAPER 92-2600) Copyright

An Euler method is applied to the steady subsonic leading-edge vortex flow about a 65-deg sharp-edged cropped delta wing at

incidences close to the incidence at which vortex breakdown is observed in wind tunnel experiments. Above a critical value of the incidence the pseudotime dependent numerical procedure fails to attain a steady-stage solution. The occurrence of this 'solution breakdown' indicates the limits of the domain of applicability of the steady-flow Euler method for the case of subsonic leading-edge vortex flow. Analysis of the converged solution at incidences just below the critical value reveals that above the aft part of the wind the velocity and vorticity distribution within the vortex core undergoes a remarkable change. Author

A92-45487#

AN IMPROVED APPROACH FOR THE COMPUTATION OF TRANSONIC/SUPERSONIC FLOWS WITH APPLICATIONS TO AEROSPACE CONFIGURATIONS

RANJIT COLLERCANDY (ONERA, Chatillon, France) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 125-140. Institute supported by CNES. refs (AIAA PAPER 92-2613; ONERA, TP NO. 1992-72) Copyright

An improved approach for numerically solving the 3D time dependent Euler equations has been developed. The cell-centered upwind finite volume methods are adopted for the spatial discretizations. Time-stepping to solve the discretized equations is carried out by an explicit three-stage Stetter's predictor-corrector scheme. This technique is found to be robust for the multiblock computations of transonic and supersonic flows. The important feature of this code is that, for transonic flows, there is no need for slope limiters. The validity of the present approach is successfully demonstrated in transonic flow conditions (NACA 0012 airfoil, ONERA M6 wing, GARTEUR F4 wing, turbopan nacelle, Hermes space plane, Hermes space plane atop its launcher Ariane 5). Even though only a limited number of supersonic test cases were computed, these confirmed the robustness and accuracy of the method. Author

A92-45507#

APPLICATION OF AN UNSTRUCTURED NAVIER-STOKES SOLVER TO MULTI-ELEMENT AIRFOILS OPERATING AT TRANSONIC MANEUVER CONDITIONS

LUCA STOLCIS and LESLIE J. JOHNSTON (University of Manchester Institute of Science and Technology, England) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 352-360. refs (AIAA PAPER 92-2638) Copyright

The development of a numerical prediction method for the viscous transonic flow around multielement, high-lift aerofoil sections is summarized. The method involves solution of the Reynolds-averaged Navier-Stokes equations using a cell-centered, finite-volume spatial discretization and an explicit multistage scheme to time march to steady-state solutions. The mean-flow equations are solved in conjunction with a two-equation, high-Reynolds number k-epsilon turbulence model, in order to deal adequately with the complex flow physics. The geometric complexity associated with multielement aerofoils is addressed by adopting unstructured computational grids. In this way, fully representative geometries can be handled including blunt trailing edges and sharp-edged cut-outs in flap and slat cove regions. A detailed evaluation is presented of the predictive capability of the resulting method for the SKF 1.1 aerofoil/maneuver flap configuration. Author

A92-45523#

AN UNFACTORED IMPLICIT SCHEME FOR 3D INVISCID TRANSONIC FLOWS

STEFANO PAOLETTI, MARCELLO VITALETTI (IBM European Center for Scientific and Engineering Computing, Rome, Italy), and PETER STOW (Rolls-Royce, PLC, Dept. of Theoretical Science, Derby, England) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 2.

Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 518-527. refs
(AIAA PAPER 92-2668) Copyright

An unfactored implicit scheme for the 3D Euler equations is compared with the alternating-direction-implicit (ADI) scheme. Emphasis is on the effect of the factorization error on the convergence to a steady-state solution. The unfactored scheme can achieve a faster convergence by the exploitation of larger time-steps but requires the solution of large sparse systems of equations. The conjugate-gradient-squared iterative algorithm is applied to the unfactored system using the ADI product of block-tridiagonal factors as a preconditioner, and the method was tested on transonic and subsonic test cases. Author

A92-45546#

TRANSONIC UNSTEADY INVISCID AND VISCOUS FLOW'S SIMULATION AROUND 2-D MOVING BODIES

M. P. THOMADAKIS and S. TSANGARIS (Athens, National Technical University, Greece) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 764-774. refs
(AIAA PAPER 92-2704) Copyright

The paper presents a generalized method for the numerical simulation of the unsteady compressible flow around stationary or moving bodies. The unsteady Euler and Reynolds-averaged Navier-Stokes equations are numerically solved using a first or second order time accurate implicit factored scheme. The aim is to investigate the effect that the higher order time accuracy has on the solution, to compare the inviscid and viscous results for the same flow problem and to investigate the influence of the grid refinement on the numerical prediction. It is shown that when a second order time accurate scheme is implemented instead of a first order one, larger time steps can be used and so computer time savings of up to 50 percent can be obtained without destroying the accuracy of the solution. Both the inviscid and viscous solutions predict the same physics of the flow, although differences are observed in the values of the total forces and in the location of the shock waves. Comparison between numerical results and experimental data is quite satisfactory, but reveals that there is a lot to be done in both areas of investigations before the prediction of unsteady compressible flows becomes a routine procedure. Author

A92-45558#

A NEW AUTOMATIC GRID GENERATION ENVIRONMENT FOR CFD APPLICATIONS

D. BERTIN (Aerospatiale, Division Avions, Toulouse, France), J. LORDON (Control Data France, Toulouse), and V. MOREUX (Aerospatiale, Division Avions, Toulouse, France) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 895-903. refs
(AIAA PAPER 92-2720) Copyright

This new grid generation environment enables the fluid volume around complex shapes to be meshed rather easily and quickly. The resulting mesh is structured multiblock, it can be generated interactively or in replay mode. Overall, the new system makes it possible to decrease the CFD design cycle time. The system principles and practical handling are described. Some examples of meshes around industrial configurations and samples of aerodynamic calculations are detailed and shown. Author

A92-45565#

EXPERIMENTAL INVESTIGATION OF VORTEX DYNAMICS ON DELTA WINGS

G. GUGLIERI (CNR, Turin, Italy) and F. B. QUAGLIOTTI (Torino, Politecnico, Turin, Italy) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 982-989. refs
(AIAA PAPER 92-2731) Copyright

Delta wing vortex dynamics was investigated by extensive

wind tunnel testing of a 65 degree delta wing. At moderate angles of attack the leeward flow field is dominated by organized vortical flow structures from the leading edge. At high angles of attack vortex breakdown leads to changes in the aerodynamic coefficients which affect wing performance. Vortex breakdown was studied using tests on the delta wing under static and dynamic conditions with forced oscillatory motions. Varying angles of attack and Reynolds numbers were used to determine factors which influence vortex breakdown. Results indicate that the position of breakdown is determined by the pressure gradient along the vortex, initial axial core velocity and sideslip angle. Flow visualization techniques were effective in visualization of vortical flow and breakdown in dynamic conditions. The correlation of pressure gradients with force measurements and flow visualizations at varying attack and sideslip angles under static and dynamic conditions, and to different oscillation frequencies for dynamic conditions are presented. The data acquisition system, pressure measurement system, and flow visualization method are described. A.O.

A92-45569#

PREDICTION OF THE VISCOUS TRANSONIC AERODYNAMIC PERFORMANCE OF SUPERCRITICAL AEROFOIL SECTIONS

LESLIE J. JOHNSTON (University of Manchester Institute of Science and Technology, England) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1016-1025. refs
(AIAA PAPER 92-2653) Copyright

A recently-developed computational method is used to predict the aerodynamic performance of the CAST 7 supercritical aerofoil section over a wide range of transonic conditions, from fully-subcritical flow to supercritical flow with shock-induced separation. The method is based on a finite-volume spatial discretization of the compressible Reynolds-averaged Navier-Stokes equations. Reynolds stresses appearing in the governing mean-flow equations are modeled via the eddy viscosity concept, in conjunction with a one-equation turbulence model. This latter model involves the solution of an additional modeled transport equation for the turbulent kinetic energy. Solutions are obtained by time-marching the unsteady flow equations to the steady-state using an explicit multi-stage scheme. Results are presented for the CAST 7 aerofoil, covering incidence angle sweeps at freestream Mach numbers of 0.70 and 0.76, and a Mach number sweep at constant incidence angle. Comparisons with experimental measurements indicate that the general features of the surface pressure distribution and trends for the integrated loads are reasonably well-predicted. Author

A92-45827

CALCULATION OF POTENTIAL FLOW AROUND AIRFOILS USING A DISCRETE VORTEX METHOD

GEORGE GIANNAKIDIS (Imperial College of Science, Technology, and Medicine, London, England) AIAA Journal (ISSN 0001-1452), vol. 30, no. 7, July 1992, p. 1689, 1690. Abridged. Research supported by Department of Trade and Industry of England. refs
Copyright

A discrete vortex method for calculating the potential flow around arbitrary 2D airfoils is presented, in which the Kutta-Joukowski condition is introduced as an extra equation and the final overdetermined linear system of equations is solved using Gaussian elimination with partial pivoting to remove the redundancy (instead of dropping one equation as was done in previous methods). A comparison of the present scheme with the widely used methods of Smith and Hess (1966) and Kennedy and Marsden (1976) showed that the present method offers higher accuracy for the same computational cost. I.S.

A92-45839

VISCOUS HIGH-SPEED FLOW COMPUTATIONS BY ADAPTIVE MESH EMBEDDING TECHNIQUES

F. GRASSO, M. MARINI, and M. PASSALACQUA (Roma I, Università, Rome, Italy) AIAA Journal (ISSN 0001-1452), vol.

30, no. 7, July 1992, p. 1780-1788. Previously cited in issue 07, p. 969, Accession no. A91-21381. refs
Copyright

A92-46441

THE INVISCID COMPRESSIBLE GOERTLER PROBLEM IN THREE-DIMENSIONAL BOUNDARY LAYERS

ANDREW DANDO (Manchester, Victoria University, England) Theoretical and Computational Fluid Dynamics (ISSN 0935-4964), vol. 3, no. 5, May 1992, p. 253-265. Research supported by SERC. refs
Copyright

Numerical solutions for the growth rates of Goertler vortices in a compressible three-dimensional flow in the inviscid limit of a large Goertler number are investigated. A range of Mach numbers are examined and find that there are three different types of behavior for the mode growth-rate, corresponding to whether the flow is incompressible, has a Mach number small enough so that temperature-adjustment-layer modes do not appear in the two-dimensional case, or has a Mach number large enough so that they do. It is found that it takes a considerably greater crossflow to destroy the Goertler vortices for moderate Mach numbers than it did in the incompressible case looked at by Bassom and Hall (1991). From this it is believed that Goertler vortices may well still be a cause of transition for many practical compressible inviscid three-dimensional flows. Author

A92-46900

EFFECT OF MODEL COOLING ON PERIODIC TRANSONIC FLOW

S. RAGHUNATHAN, F. ZARIFI-RAD (Belfast, Queen's University, Northern Ireland), and D. G. MABEY (Royal Aerospace Establishment, Bedford, England) AIAA Journal (ISSN 0001-1452), vol. 30, no. 8, Aug. 1992, p. 2080-2086. Previously cited in issue 17, p. 2857, Accession no. A91-42562. refs
Copyright

A92-46948

EXPERIMENTAL AND NUMERICAL STUDY OF FLOW AROUND HELICOPTER ROTOR BLADE TIPS

B. BENCHERIFA and J. MARCILLAT (Institut de Mecanique des Fluides, Marseille, France) IN: AHS International Specialists' Meeting on Rotorcraft Basic Research, Atlanta, GA, Mar. 25-27, 1991, Proceedings. Alexandria, VA, American Helicopter Society, 1991, p. 24-1 to 24-13. Research supported by ONERA. refs

The main results of experimental and numerical studies of flow around blade tips presented emphasize aerodynamic coefficients or limiting flow at a two-surface wall, about new shapes simulated by semispan wings placed in an $M = 0.6$ wind tunnel. Some numerical results obtained through an FIDAP code using a finite element method to solve the Navier-Stokes equations are also presented. Two examples of unsteady, 2D, incompressible viscous flows with separation are presented at 15 and 34 deg, for Re of 1000. Author

A92-46954* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EXPERIMENTAL AND COMPUTATIONAL STUDIES OF HOVERING ROTOR FLOWS

M. NSI MBA (Institut de Mecanique des Fluides, Marseille, France), K. RAMACHANDRAN (Flow Analysis, Inc.; NASA, Ames Research Center, Moffett Field, CA), and F. X. CARADONNA (U.S. Army, Aviation Systems Command; NASA, Ames Research Center, Moffett Field, CA) IN: AHS International Specialists' Meeting on Rotorcraft Basic Research, Atlanta, GA, Mar. 25-27, 1991, Proceedings. Alexandria, VA, American Helicopter Society, 1991, p. 30-1 to 30-17. refs
(Contract DRET-89-1433)

HELIX-I, an essentially standard full-potential CFD helicopter rotor code, is unique in its use of the Clebsch kinematical flow description to specify a freely convecting wake and its capacity for predicting hover performance. A study is presently performed to assess the method's sensitivity to grids and solution-starting

techniques. The effects of these parameters on thrust, power, load distribution, and wake geometry are ascertained and compared with an extensive rotor data base. The use of a fairly accurate starting solution yields no obvious advantage over the use of a novel starting method which employs a succession of diminishing artificial flows. O.C.

A92-46958

A NEW INTEGRAL EQUATION FOR POTENTIAL COMPRESSIBLE AERODYNAMICS OF ROTORS IN FORWARD FLIGHT

M. GENNARETTI, O. MACINA, and L. MORINO (Roma I, Università, Rome, Italy) IN: AHS International Specialists' Meeting on Rotorcraft Basic Research, Atlanta, GA, Mar. 25-27, 1991, Proceedings. Alexandria, VA, American Helicopter Society, 1991, p. 34-1 to 34-8. Research supported by ASI. refs

The Gennaretti (1989) boundary integral equation methodology for the analysis of unsteady, compressible potential flows around helicopter rotors in hover and forward flight was extended by Macina (1990) to the case of arbitrary motion. Novel numerical results have been obtained by these means for isolated rotors in both hover and forward flight. These results were derived through the application of a zeroth-order boundary-element discretization of the integral equation for the velocity potential. O.C.

A92-47038

MESH ADAPTION FOR 2D TRANSSONIC EULER FLOWS ON UNSTRUCTURED MESHES

R. RICHTER and P. LEYLAND (Lausanne, Ecole Polytechnique Federale, Ecublens, Switzerland) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 27-39. refs
Copyright

Shock fitting for transonic flows is investigated via successive refinement techniques on unstructured triangular meshes. The relative mesh dependency is also studied using respectively a centered explicit scheme, with artificial viscosity and an upwind, approximate Riemann solver type scheme, without local refinement. A semiinteractive graphics package is incorporated to make a workstation feasibility of such codes. The advantages of unstructured meshes, and their flexibility of localized refinements, retain an optimal solution for a minimal number of mesh points. The first scheme is a standard Jameson type centered scheme with artificial dissipation of second and fourth order, based on a Galerkin approximation on dual control volumes rather than cell vertex ones. The artificial dissipation terms are based on bisegment flux control. The approximate Riemann solver is based on Osher's scheme with implicit time-stepping. Only convergence of steady state is considered here. Author

A92-47041

MESH ADAPTIVITY WITH THE QUADTREE METHOD

A. EVANS, M. J. MARCHANT, J. SZMELTER, and N. P. WEATHERILL (Swansea, University College, Wales) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 67-78. Research supported by Royal Aerospace Establishment and CEC. refs
Copyright

In this paper, a data structure, loosely based around a quadtree, is introduced and developed to manage an adaptive point enrichment technique for structured quadrilateral meshes. The technique allows the interfaces between enriched regions to be easily detected and transitional interface elements constructed. The approach is applied to the adaptive solution of the inviscid Euler equations for two dimensional transonic flows. Author

A92-47061

3-D NUMERICAL GRID GENERATION FOR THE TRANSONIC FLOW ANALYSIS ABOUT MULTI-BODIES

U. GULCAT and H. R. KUL (Istanbul Technical University, Turkey)

IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 369-375. refs
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An algebraic grid generation scheme suitable for transonic flow analysis about multi-bodies is presented. In the grid generation process the flow domain external to the bodies are divided into blocks and each block is discretized with finite volumes for which the conservation laws are satisfied using Euler's equations. These blocks are matched together in such a way that the Finite Volume Method can handle the slip surfaces properly. The proposed technique is applied to generate a grid around a wing with an external body attached to the wing with a pylon. The numerical results obtained for a 2D flow past the wing section at free stream Mach number of 0.95, to simulate a transonic maneuver, is presented in terms of surface pressure distribution. Author

A92-47079

NEW CONCEPTS FOR MULTI-BLOCK GRID GENERATION FOR FLOW DOMAINS AROUND COMPLEX AERODYNAMIC CONFIGURATIONS

S. P. SPEKREYSE, J. W. BOERSTOEL (National Aerospace Laboratory, Amsterdam, Netherlands), and P. L. VITAGLIANO (Alenia S.p.A., Gruppo Aerei da Trasporto, Naples, Italy) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 719-730. Research supported by Netherlands Agency for Aerospace Programs, Aeritalia, National Aerospace Laboratory, et al. refs
Copyright

A multiblock grid generation procedure is described which is suitable for constructing multiblock grids in numerical simulations of flows around complex aerodynamic configurations. Novel aspects of the procedure are its use of topology and geometry of block decomposition specified first by an interactive domain modeler, compound edges and faces, grid embedding, grid lines which are C-deg-continuous only over block faces, and a biharmonic solver for grid generation in faces. C.D.

A92-47090

GENERATION OF UNSTRUCTURED GRIDS WITHIN A HYBRID MULTI-BLOCK ENVIRONMENT

P. N. CHILDS (Aircraft Research Association, Ltd., Bedford, England) and N. P. WEATHERILL (Swansea, University College, Wales) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 899-911. Research supported by Royal Aerospace Establishment. refs
Copyright

It is demonstrated how a local region of embedded unstructured grid may be used to extend the range of application of the multiblock approach. It is shown that techniques for surface and field grid generation are amenable to a large degree of automation within the unstructured region. Robust procedures are developed to maintain boundary integrity and to enable structured and unstructured grids to be interfaced. C.D.

A92-47782

TOTAL LOSSES IN TURBULENT FLOWS INSIDE CONICAL DIFFUSERS [STRATY CALKOWITE PRZEPLYWU TURBULENTNEGO W DYFUZORACH STOZKOWYCH]

KRZYSZTOF J. JESIONEK (Wroclaw Technical University, Poland) and ARKADII E. ZARIANKIN (Moskovskii Energeticheskii Institut, Moscow, Russia) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 173-180. In Polish. refs

A method of calculation of a diffuser flow boundary layer is presented that ensures a high concurrence of theoretical results with experimental investigation findings. A general equation is given,

and an adequate detailed expression for the conical diffusers is obtained. The presented method does not require the use of additional, experimental correction coefficients. Author

A92-47876#

NUMERICAL AND EXPERIMENTAL INVESTIGATION OF RAREFIED COMPRESSION CORNER FLOW

A. CHPOUN, J. C. LENGAND, and K. S. HEFFNER (CNRS, Laboratoire d'Aerothermique, Meudon, France) AIAA, Thermophysics Conference, 27th, Nashville, TN, July 6-8, 1992. 12 p. refs
(Contract DRET-89-080)
(AIAA PAPER 92-2900) Copyright

This paper presents the results of an experimental and numerical work carried out at the Laboratoire d'Aerothermique du CNRS, in order to investigate a rarefied hypersonic flow over a compression corner at two levels of rarefaction. The numerical work consisted of calculations of the flow by both the continuum model (Navier-Stokes (NS) full equations + wall temperature jump and velocity slip) and the DSMC method. In the experimental work, the density field over the model was measured by the electron-beam fluorescence technique in the SR3-CNRS rarefied hypersonic wind tunnel. The heat flux of the wall was also measured by thin skin technique. The principal aim of the work is to discuss the ability and the accuracy of the continuum model (NS) for the resolution of such rarefied flows by comparing results with different approaches. Author

A92-48207

EXPERIENCE WITH THE JOHNSON-KING TURBULENCE MODEL IN A TRANSONIC TURBINE CASCADE FLOW SOLVER

N. B. WOOD (National Power Technology and Environmental Centre, Leatherhead, England) International Journal of Heat and Fluid Flow (ISSN 0142-727X), vol. 12, no. 2, June 1991, p. 158-165. refs
Copyright

Experience is described of the application of the Dawes Navier-Stokes solver to a turbine test case involving shock-boundary-layer interaction. Modifying the implementation of the algebraic eddy-viscosity turbulence model gave improved agreement between the predictions and the experimental results. In order to improve the predictions still further, the nonequilibrium turbulence model of Johnson and King was incorporated into the code. This gave limited further improvement in the overall loss prediction, but the base pressure prediction was not improved. Only a minor shock-induced separation was predicted, compared with the increasing major separation observed in cascade tests with increasing outlet Mach number. Better prediction of the test flow may require the incorporation of higher-order turbulence models, in which the physics of the flow is more fully represented. Additionally, three-dimensional and unsteady capability may be needed. Author

A92-48577

CALCULATION OF FULLY THREE-DIMENSIONAL SEPARATED FLOWS WITH AN UNSTEADY VISCOUS-INVISCID INTERACTION METHOD

J. C. LE BALLEUR and P. GIROUDROUX-LAVIGNE (ONERA, Chatillon, France) (International Symposium on Numerical and Physical Aspects of Aerodynamic Flows, 5th, California State University, Long Beach, CA, Jan. 13-15, 1992) ONERA, TP no. 1992-1, 1992, 15 p. Research supported by Ministere de la Defense. refs
(ONERA, TP NO. 1992-1)

This paper presents a fully 3D time-consistent turbulent viscous-inviscid interaction technique, based on a marching thin-layer 3D-numerical method that switches locally a direct or inverse mode of solution, on a modeling of parametric 3D-turbulent velocity profiles, and on the 'semiimplicit' unsteady coupling algorithm, extended in 3D-flows. 3D turbulent separations are shown to be accessible to the calculation techniques based on

02 AERODYNAMICS

viscous-inviscid interaction. The shock-induced transonic 3D-separation on rectangular wings is successfully computed, with standard grids, properly refined in chord but not in span. R.E.P.

A92-48579

SEPARATION AND VORTEX FORMATION IN TURBULENT FLOWS

JEAN M. DELERY (ONERA, Chatillon, France) (Caribbean Conference on Fluid Dynamics, 2nd, University of the West Indies, St. Augustine, Trinidad and Tobago, Jan. 5-8, 1992) ONERA, TP no. 1992-7, 1992, 10 p. Research supported by CNES and Ministère de la Defense. refs
(ONERA, TP NO. 1992-7)

A separation process in 3D flows and the formation of vortical structures were analyzed using the critical-point theory. The latter makes it possible to correctly interpret the surface flow patterns which constitute the imprints of the outer flow and to give a rational and coherent description of the vortical system generated by separation. O.G.

A92-48585

THE DESIGN AND TESTING OF AN AIRFOIL WITH HYBRID LAMINAR FLOW CONTROL

J. RENEUX and A. BLANCHARD (ONERA, Chatillon, France) (European Forum on Laminar Flow Technology, 1st, Hamburg, Federal Republic of Germany, Mar. 16-18, 1992) ONERA, TP no. 1992-22, 1992, 12 p. Research supported by Direction Generale de l'Aviation Civile, Ministère de la Defense, and Airbus Industrie. refs
(ONERA, TP NO. 1992-22)

This study focuses on the design of an airfoil with hybrid laminar flow control and describes the performance of a wing employing this basic airfoil. Three tests on this airfoil were conducted in the ONERA-CERT T2 cryogenic wind tunnel. It is shown that the laminization of the upper surface alone will result in a 5.6 percent reduction in fuel consumption which is sufficient to permit the use of a high lift leading edge such as a Krueger flap. R.E.P.

A92-48701#

ADVANCED CFD SIMULATION AND TESTING OF COMPRESSOR BLADING IN THE MULTISTAGE ENVIRONMENT

FREDERIC FALCHETTI (SNECMA, Moissy-Cramayel, France) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 10 p. Research supported by Service Technique des Programmes Aeronautiques and DRET. refs
(AIAA PAPER 92-3040) Copyright

An account is given of an experimental program conducted to investigate the flow behavior of the four rear stages of a high-speed compressor, with attention to the use of miniature transverse probes in conjunction with laser anemometry. A CFD study is then conducted of the 3D viscous effects encountered. The 3D Navier-Stokes solver used in the compressor's design methodology is shown to be a critically important tool in turbomachine aerodynamics. Expected improvements in high pressure compressor design as a result of this work are noted. O.C.

A92-48702#

NUMERICAL COMPUTATIONS OF TRANSONIC FLOWS THROUGH CASCADES

A. TERLIZZI, P. DI MARTINO, S. COLANTUONI (Alfa Romeo Avio S.p.A., Pomigliano d'Arco, Italy), and F. BASSI (Milano, Politecnico, Milan, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 9 p. refs
(AIAA PAPER 92-3041) Copyright

A Navier-Stokes solver is described for 2D turbomachinery flows characterized by two features well suited for application in the design of modern turbine bladings: (1) it uses an adaptive mesh embedding technique to improve locally the accuracy of the numerical solution; and (2) it can simulate fluid injection at specified locations along the blade surface. Computational results are

presented to show the flexibility of the proposed mesh-embedding technique applied to 2D turbine cascades and the capability of the code to describe the aerodynamic features of the coolant injection. Author

A92-49515

THE SIMULATION OF INVISCID, COMPRESSIBLE FLOWS USING AN UPWIND KINETIC METHOD ON UNSTRUCTURED GRIDS

J. S. MATHUR and N. P. WEATHERILL (Swansea, University College, Wales) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 15, no. 1, July 15, 1992, p. 59-82. Research supported by Ministry of Defence Procurement Executive. refs
Copyright

A kinetic flux-vector-splitting method has been used to solve the Euler equations for inviscid, compressible flow on unstructured grids. This method is derived from the Boltzmann equation and is an upwind, cell-centered, finite volume scheme with an explicit time-stepping procedure. The Delaunay triangulation has been used to generate the grids. The approach is demonstrated for three flowfield simulations, namely the subsonic flow over a two-component high-lift-airfoil, the transonic flow over an aerofoil and the supersonic flow in a channel. Author

A92-50121

A REVIEW OF SCALE EFFECTS IN UNSTEADY AERODYNAMICS

D. G. MABEY (Imperial College of Science, Technology, and Medicine, London, England) Progress in Aerospace Sciences (ISSN 0376-0421), vol. 28, no. 4, 1991, p. 273-321. refs
Copyright

The importance of scale effects is recognized generally in steady aerodynamics but is often ignored in unsteady aerodynamics. An attempt is made to remedy this situation by the compilation of a review of information on the influence of Reynolds number from a wide range of unsteady aerodynamic tests, with particular reference to wing flows. The unsteady tests considered are buffet and buffeting, dynamic tests of airfoils and wings, pressure measurements, oscillatory control surface derivatives, and stability derivatives. The review suggests that for the usual recommended model conditions with fixed transition, scale effects are small for fully-attached or well-separated flows, but may be large close to incipient separation. With fixed transition extrapolation from model to full scale Reynolds numbers is usually possible. In contrast, with free transition scale effects can be large for both attached and separated flows. Much more research is needed into the magnitude of scale effects in unsteady flows at transonic speeds. Some test cases for the prediction of scale effects in unsteady aerodynamics are suggested. Author

A92-52028

A DIRECT VISCOUS-INVISCID INTERACTION METHOD FOR THE FLOW CALCULATION AROUND AIRFOILS

V. MUSAT (Applied Mathematics Institute, Bucharest, Romania) Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (ISSN 0035-4074), vol. 37, no. 3, May-June 1992, p. 275-287. refs

A direct viscous-inviscid interaction method is presented together with results obtained for flows around three different airfoils as a function of the angle of attack. The method, comprising a simple inviscid flow method and an integral method for viscous flow, takes the wake effect into account. The results obtained with this method agree well with those obtained with other methods and with experiments, for angles up to separation. L.M.

A92-52034

AN AERODYNAMICAL ANALYSIS OF 'SEESAW' TYPE ROTOR FOR AUTOGYRO

D. MIRICA (Aviation Institute, Bucharest, Romania) Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (ISSN 0035-4074), vol. 37, no. 2, Mar.-Apr. 1992, p. 187-202. refs

An aerodynamic analysis of an autogyro rotor having a seesaw-type flapping hinge is presented, with particular attention given to the calculation of the overall rotor-aerodynamic characteristics. Calculation results are compared with those obtained previously concerning a three-blade rotor having independent flapping and a three-blade rotor fitted with a variation device for a spider-type blade incidence. L.M.

A92-52682 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A GENERAL EXPLICIT OR SEMI-EXPLICIT ALGORITHM FOR COMPRESSIBLE AND INCOMPRESSIBLE FLOWS

O. C. ZIENKIEWICZ and J. WU (Swansea, University College, United Kingdom) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 35, no. 3, Aug. 30, 1992, p. 457-479. Research supported by NASA. refs (Contract NAGW-2127)

Copyright

A unified finite element algorithm is developed which is applicable to a wide range of problems of fluid mechanics without recourse to artificial, empirically determined factors. In its explicit form, the algorithm is similar to the Taylor-Galerkin scheme and is easily adopted to standard codes. The scheme proposed here possesses sufficient natural balancing diffusion and thus reduces and sometimes eliminates the need for special 'shock capturing' diffusion. The efficiency of the algorithm is demonstrated using several examples ranging from incompressible through transonic regions to supersonic flows. V.L.

A92-52734

HYPERSONIC FLOW CALCULATIONS AROUND A 3D DELTA WING AT LOW KNUDSEN NUMBERS

F. GROENGIESSER, H. NEUNZERT, J. STRUCKMEIER, and B. WIESEN (Kaiserslautern, Universitaet, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 332-336. refs

Copyright

This paper presents numerical results for hypersonic flows around a 3D delta-wing at low Knudsen numbers (i.e., near the continuum regime). The underlying body geometry corresponds to one of the test cases on rarefied gas regime proposed for the workshop on hypersonic flow, which was held in Antibes (France), January 1990. The numerical method used in the calculations is the so-called finite-pointset-method (FPM) developed at the university of Kaiserslautern during the last year. The paper shows that the FPM is an efficient alternative method beside the well-known Monte-Carlo-methods. Author

A92-52748

HEAT TRANSFER TO A DELTA WING AND TWO WAVERIDER WINGS IN RAREFIED HYPERSONIC FLOW

E. M. GALLOWAY, M. R. GILMORE, R. W. JEFFERY, and J. K. HARVEY (Imperial College of Science, Technology, and Medicine, London, United Kingdom) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 505-513. Sponsorship: Ministry of Defence of United Kingdom. refs

(Contract MOD-AT/2037/331)

Copyright

This paper presents data on the heat transfer to a family of wings of the same planform. The flow conditions fall within the hypersonic rarefied regime. The 'off design' high altitude performance of the waverider wings is thus being examined in comparison with the delta. Wind tunnel measurements for the compression side of the wings are presented and, for the case of the 5 deg waverider, comparisons are made with 3D DSMC computations. The agreement is good. Computed results for the leeward surface heat transfer and for the overall force coefficients are also presented. Author

A92-52753

RAREFIED GAS FLOW AROUND A DISC WITH DIFFERENT ANGLES OF ATTACK

F. GROENGIESSER, H. NEUNZERT, J. STRUCKMEIER, and B. WIESEN (Kaiserslautern, Universitaet, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 546-553. refs

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This paper presents a comparison between measurements from a windtunnel and calculations performed by the Finite-Point-set-Method (FPM) for solving the Boltzmann equation. The case considered is the flow around a circular disk at different angles of attack. The comparison covers the whole range of Knudsen numbers from nearly continuum flow to nearly free molecular flow. The dependence of the aerodynamic coefficients on different gas-surface interaction models, especially the Maxwell-model with an accommodation models, especially the Maxwell-model with an accommodation coefficient, is also investigated. Author

A92-52755

EXPERIMENTS ON SEPARATION AT A COMPRESSION CORNER IN RAREFIED HYPERSONIC FLOWS

CH.-H. CHUN (DLR, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 562-569. Research supported by AMDBA. refs

Copyright

The shock/boundary layer interaction and flow separation induced by a 2-dimensional compression corner is studied by flow visualizations in the merged-layer flow regime of low-density hypersonic flow. Flow visualizations are carried out by means of gas glow discharge and oil flow picture. Author

A92-52764

FORCE AND HEAT TRANSFER ON A DISC IN RAREFIED FLOW

H. LEGGE (DLR, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, Germany), K. NANBU, and S. IGARASHI (Tohoku University, Katahira, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 679-686. Research supported by AMDBA. refs

Copyright

Force and heat transfer measurements on a disk at angles of attack 45, 60, 75, and 90 deg in the hypersonic transition flow regime are compared to results of the Direct Simulation Monte Carlo Method. Good agreement was obtained for argon with complete accommodation and helium assuming a mixture of complete accommodation and diffuse elastic reflection with an energy accommodation coefficient 0.6. Author

A92-52770

MONTE CARLO SIMULATION OF THE HYPERSONIC MON- AND DIATOMIC GAS FLOW PAST A DISK AT AN ANGLE OF ATTACK

FRANK BERGEMANN (DLR, Institut fuer Theoretische Stroemungsmechanik, Goettingen, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 737-744. refs

Copyright

The 3D hypersonic flow past a disk at an angle of attack is investigated for mon- and diatomic gases by the direct simulation Monte Carlo (DSMC) method. Hard sphere molecules, diffuse reflection and, for the diatomic gas, the Larsen-Borgnakke model are assumed. The drag, lift and heat transfer coefficients and in the monatomic case the recovery temperature for Knudsen numbers $Kn = 0.05$ -infinity are presented and compared with

experimental data for argon and nitrogen from Legge. For the monatomic case the values of a previous DSMC simulation by Nanbu are also given for comparison. Generally there is good agreement between DSMC simulations and the experimental results. In the diatomic case force and heat transfer coefficients agree with the experimental data as good as in the monatomic case. Furthermore in the diatomic gas flow at an angle of attack of 90 deg, significant nonequilibrium of the translational and the rotational temperature is observed on the stagnation streamline.

Author

A92-52848

THE NUMERICAL SIMULATION OF FLOW ABOUT INSTALLED AERO ENGINE NACELLE USING A FINITE ELEMENT EULER SOLVER ON UNSTRUCTURED MESHES

J. PEIRO, J. PERAIRE (Imperial College of Science, Technology, and Medicine, London, United Kingdom), K. MORGAN, O. HASSAN (Swansea, University College, United Kingdom), and N. BIRCH (Rolls Royce, PLC, Derby, United Kingdom) *Aeronautical Journal* (ISSN 0001-9240), vol. 96, no. 956, June-July 1992, p. 224-232. Research supported by Rolls Royce, PLC and Royal Aerospace Establishment. refs

Copyright

The application of the unstructured mesh system FLITE3D.0 to the numerical analysis of the inviscid Euler flow past installed aero-engine nacelle is described. The main features of the system are detailed and the approach is demonstrated by simulating the flow over a Rolls-Royce model of a twin-engined civil transport aircraft with long-cowl nacelle powerplants. The computed pressure distributions are compared with the measurements produced by transonic wind tunnel experiments.

Author

A92-52973

SOLUTION OF EULER EQUATIONS WITH UNSTRUCTURED MESH - 3-D CASE

G. D. MORTCHELEWICZ (ONERA, Chatillon, France) *La Recherche Aeronautique* (English Edition) (ISSN 0379-380X), no. 6, 1991, p. 17-25. refs

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An effective and reliable FEM for solving the nonsteady 3D Euler equations is presented. The small-motion hypothesis offers the possibility of realizing nonsteady solutions for fairly reasonable computation costs. A satisfactory comparison of experimental and numerical data is achieved, despite the rarefied grids employed.

R.E.P.

A92-53078

HOT-WIRE MEASUREMENTS IN TURBULENT TRANSONIC FLOWS

S. BARRE, P. DUPONT, and J. P. DUSSAUGE (Institut de Mecanique Statistique de la Turbulence, Marseille, France) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 11, no. 4, 1992, p. 439-454. Research supported by CNRS and DRET. refs

Copyright

In transonic flows, problems arise in hot-wire anemometry at moderate Reynolds number, and at low and moderate overheat of the wire. However, these operating parameters are necessary if velocity and temperature fluctuations are to be measured by the technique of fluctuation diagrams. A measurement method adapted to this range is proposed. The sensitivities of the hot wire to the mass flux, Mach number and total temperature are defined and determined by calibration. The results are verified in known turbulent flows: an equilibrium boundary layer and a free shear flow containing large transonic zones. The present method gives results in agreement with classical results. In contrast, neglecting the sensitivity to the Mach number, as is usual with supersonic flows, would lead to unrealistically low levels of turbulence. A simplified method, already used for supersonic flows, in which the hot wire is operated at a single overheat, is proposed and validated for the transonic range.

Author

A92-53079

REMARKS ON THE RELATION BETWEEN LIFT INDUCED DRAG AND VORTEX DRAG

P. ARDONCEAU and G. AMANI (Ecole Nationale Supérieure de Mecanique et d'Aerotechnique, Poitiers, France) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 11, no. 4, 1992, p. 455-460. refs

Copyright

Some results concerning the relation between vortex drag and lift-induced drag recently published in the literature (Chometon and Laurent, 1990) are reexamined in quantitative terms. In particular, it is noted that the momentum balance in the wake of a lifting wing gives a correct estimate of the lift-induced drag, provided that the survey area is large enough to include all the vortex energy.

V.L.

A92-53080*

National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

NONLINEAR DEVELOPMENT AND SECONDARY INSTABILITY OF LARGE-AMPLITUDE GOERTLER VORTICES IN HYPERSONIC BOUNDARY LAYERS

Y. FU and P. HALL (Manchester, Victoria University, United Kingdom) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 11, no. 4, 1992, p. 465-510. refs

(Contract NAS1-18605; NAS1-18107; AF-AFOSR-89-0042)

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The weakly nonlinear development of large-amplitude Goertler vortices in a small neighborhood of the neutral stability position given by the linear theory is considered. It is shown that if the basic state and the wall curvature satisfy a certain condition, the Goertler vortices will grow until they become so large as to drive a mean flow correction as large as the basic state. Attention is then given to the further downstream evolution of these large-amplitude vortices, and it is shown that the vortices have a triple layer structure which consists of a region of vortex activity bounded by two transition layers over which the amplitude of the harmonic part of the vortex decays to zero exponentially. The positions of the two transition layers are found to be governed by a free boundary problem, which is solved for a number of curvature distribution cases. The secondary instability of the two transition layers is investigated with respect to traveling waves which are $\pi/2$ out of phase in the spanwise direction with the steady Goertler vortices.

V.L.

A92-53253

INVESTIGATION OF THE TAIL BUFFETING OF THE C-101 [INVESTIGACION DEL BATANEO DE COLA DEL C-101]

F. J. SIMON and T. M. PUCHE (Construcciones Aeronauticas, S.A., Madrid, Spain) *Ingenieria Aeronautica y Astronautica* (ISSN 0020-1006), no. 328, July 1992, p. 19-32. In Spanish. refs

Copyright

A systematic analysis is conducted of the Spanish C-101 training aircraft including theoretical and experimental study to identify the origin of high-velocity buffeting and possible remedies. Attention is given to the limits of theoretical calculations as well as to the selection of a suitable figure of merit and the Mach number related to the shock wave. The analysis is used to design a modified wing form which can be used to increase the aircraft's ability to withstand stronger loading during flight. Experimental investigations are conducted in hydrodynamic and aerodynamic tunnels and in flight. The modifications to the aircraft are shown to augment its operative capacity for acceptable performance at achievable Mach numbers without significant tail buffeting.

C.C.S.

A92-54308

DETECTING 3-D, TURBULENT SEPARATION REGIONS USING UNSTEADY COMPUTERIZED THERMOGRAPHIC TECHNIQUE

RODOLFO MONTI and GENNARO ZUPPARDI (Napoli, Università, Naples, Italy) *IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities*, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 49-59. refs

Copyright

Flow separation regions were detected in incompressible low-Reynolds-number turbulent 3D flows via the implementation of an unsteady computerized thermographic technique. The technique takes advantage of the dependence of the heat transfer coefficient on the flow conditions on the body surface. The experimental equipment consists of a thermocamera, an A/D converter, and a personal computer. Tests were performed both on a bluff cylinder and a hemisphere cylinder. The bluff cylinder was tested in axisymmetric flow at Reynolds numbers ranging from 61,000 to 86,000. Tests on a hemisphere cylinder in axisymmetric flow compare well with theoretical data. Tests on a bluff cylinder in axisymmetric flow compare well with experimental data. P.D.

A92-55369#

UNDERSTANDING AND DEVELOPMENT OF A PREDICTION METHOD OF TRANSONIC LIMIT CYCLE OSCILLATION CHARACTERISTICS OF FIGHTER AIRCRAFT

JOS J. MEIJER (National Aerospace Laboratory, Amsterdam, Netherlands) and ATLEE M. CUNNINGHAM, JR. (General Dynamics Corp., Fort Worth, TX) IN: AIAA Atmospheric Flight Mechanics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 446-457. Research supported by USAF, General Dynamics Corp., Netherlands Ministry of Defence, et al. refs (AIAA PAPER 92-4501) Copyright

An analysis of steady wind tunnel data, obtained for a fighter type aircraft, has indicated that shock-induced and trailing-edge separation play a dominant role in the development of Limit Cycle Oscillations (LCO) at transonic speeds. On the basis of these data a semi-empirical LCO prediction method is being developed. Its preliminary version has been applied to several configurations and has correctly identified those which have encountered LCO. It has already shown the potential for application early in the design process of new aircraft to determine and understand the nonlinear aeroelastic characteristics. The method has been upgraded since. It will be described in its present form and results of the latest predictions will be used to further assess various parametric effects. The ultimate refinements are expected from recent unsteady wind tunnel force and pressure measurements for which a few preliminary analyses are presented. Author

A92-56331

ANALYSIS OF HELICOPTER ROTOR-FUSELAGE INTERFERENCE WITH TIME AVERAGED PRESSURE DISTRIBUTION

S. R. AHMED, J. RADDATZ (DLR, Braunschweig, Germany), and W. HOFFMANN (Braunschweig, Technical University, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 26 p. Research supported by BMFT and EEC. refs

The aerodynamic interference between main rotor and fuselage of a helicopter is investigated experimentally with the help of time averaged pressures measured on the fuselage surface. A total of 450 pressure taps were distributed over the fuselage surface in regions where the interference effects were expected to be severe. The facility used was 1:6.5 geometrically scaled down model of BO 105 helicopter operated in open test section of DLR 3.25 m x 2.8 m subsonic wind tunnel in Braunschweig. The rotor of the model has a diameter of 1.5 m and is mach-scaled. Parameters varied are thrust ratio, advance ratio and fuselage incidence. Some global flow visualization with smoke filaments was also performed. Author

A92-56332

CURRENT EUROPEAN ROTORCRAFT RESEARCH ACTIVITIES ON DEVELOPMENT OF ADVANCED CFD METHODS FOR THE DESIGN OF ROTOR BLADES (BRITE/EURAM 'DACRO' PROJECT)

G. POLZ (MBB GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 10 p. Research supported by EEC. refs

The present status of the BRITE/EURAM Pilot Phase project

DACRO is described. The project focuses on the development and validation of new CFD codes for application to the aerodynamic environment of helicopter rotor blades. Additional tasks are the reviewing of the current computational methods, the definition of possible improvements, and the selection of appropriate data bases for code validation. Achievements discussed include the development of a range of CFD design tools for advanced helicopter rotor blade airfoils and tip shades, and a better understanding and prediction of the complex flow phenomena. DACRO activities should lead to a reduction in rotor power consumption with improved helicopter operational economy, and to reduced vibrator loads and noise. C.A.B.

A92-56351

MEASUREMENTS OF THE DYNAMIC STALL VORTEX CONVECTION SPEED

R. B. GREEN, R. A. MCD. GALBRAITH, and A. J. NIVEN (Glasgow, University, United Kingdom) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 12 p. Research supported by SERC, Defence Research Agency, and Department of Energy of United Kingdom. refs (Contract AF-AFOSR-89-0397)

This paper considers the dynamic stall vortex of importance in helicopter rotor aerodynamics and discusses previous measurements of its convection speed. It emerges that an anomaly exists between the available data sets, i.e., that some workers find that the convection speed is dependent upon the aerofoil motion, while others find that this is not the case. Measurements of the convection speed from data gathered at Glasgow University for a variety of aerofoil shapes and motion types are then presented, which support the conclusion that the dynamic stall vortex convection speed is independent of aerofoil type and motion type to a first order. Author

A92-56352

NUMERICAL SIMULATION OF UNSTEADY ROTOR WAKES

A. BARON and M. BOFFADOSI (Milano, Politecnico, Milan, Italy) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 19 p. Research supported by MURST. refs

A nonlinear unsteady vortex lattice scheme is presented. It is capable to predict the instantaneous configuration of the wake and the distribution of the aerodynamic load on rotor blades during impulsive starts or arbitrarily unsteady flight conditions. Any number of independent blades, with general planform and twist distribution, moving with assigned pitch and flap angles can be treated. Rankine vortices are used to discretize vorticity. Turbulent diffusion of their cores is modeled in order to cope with the rapid roll-up process of unsteady and closely interfering wakes, without any form of tuning of the numerical parameters. The capabilities of the code are verified by comparing numerical predictions with available steady state experimental data. Also reported are some results related to realistic unsteady flight conditions. Author

A92-57363

AN AERODYNAMIC CONSIDERATION OF THE RE-ENTRY AND AEROBRAKING ENVIRONMENT OF SPACE VEHICLES

P. J. BAXENDALE and R. G. GILDERT (Bristol, University, United Kingdom) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. refs (IAF PAPER ST-92-0017) Copyright

An investigation into the environment encountered by a reentering or aerobraking space vehicle is described. The aim of that study was to produce a simple design package to enable further research to be undertaken in reentry vehicle design. The design tool produced comprises a PC-based program which enables calculation of the decelerations, heating rates, and total thermal loads experienced by a vehicle performing both simple reentry or aerobraking maneuvers. Where validation of the results has been possible, the design tool has been shown to attain accuracy of the order of 90 percent. It is deduced that the model is most accurate when applied to blunt bodies of revolution, although accurate analysis of slender bodies is possible at low angles of

incidence, i.e., incidences below the minimum body angle.

C.A.B.

N92-10988# Centre d'Etudes et de Recherches, Toulouse (France). Groupe d'Analyse Numerique.

NUMERICAL RESOLUTION OF THREE DIMENSIONAL EULER EQUATIONS IN TOTALLY UNSTRUCTURED MESH Final Report [RESOLUTION NUMERIQUE DES EQUATIONS D'EULER TRIDIMENSIONNELLES EN MAILLAGE TOTALEMENT DESTRUCTURE. RAPPORT FINAL]

PHILIPPE DELORME Dec. 1990 33 p In FRENCH

(Contract DRET-89-002-29)

(CERT-RF-1/3369-00/DERI-GAN; ETN-91-90075) Avail: CASI

HC A03/MF A01

Numerical attempts relating to the method of kinetic description of fluxes are reported. Problems at high Mach number were resolved over a preconditioning. Automatic mesh refining techniques were applied to implicit two dimensional stationary flow on the test case of the Hermes workshop. Three dimensional utilities were developed. A method already applied to chemically nonequilibrium gas mixtures was extended to real gas (quantic perfect gas) and to thermally nonequilibrium gas mixtures. ESA

N92-10989# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction Scientifique de la Resistance des Structures.

THREE DIMENSIONAL NUMERICAL METHOD FOR RESOLVING SMALL TRANSONIC PERTURBATIONS IN UNSTRUCTURED MESH Final Report [METHODE NUMERIQUE 3D DE RESOLUTION DES PETITES PERTURBATIONS TRANSSONIQUES EN MAILLAGE NON STRUCTURE. RAPPORT FINAL]

F. BANGUI Feb. 1991 63 p In FRENCH

(Contract DRET-89-34-001)

(ONERA-RT-56/3064-RY-006-R; ETN-91-90096) Avail: CASI HC

A04/MF A01

A resolution method for Euler equations in small transonic perturbations is presented. Theoretical developments to substitute for the hyperbolic type problem a discretized elliptic type problem by finite element method are reviewed. The algebra of boundary conditions on the moving parts is presented. Steady and unsteady numerical applications are given. ESA

N92-11967 ESDU International Ltd., London (England). **PITCHING MOMENT DERIVATIVE DUE TO RATE OF PITCH FOR PROJECTILES AT SUPERSONIC SPEEDS**

May 1991 21 p

(ISSN 0141-397X)

(ESDU-91004; ISBN-0-85679-766-9) Avail: ESDU

ESDU 91004 gives a semiempirical method for estimating the derivative for an axisymmetric forebody cylinder combination with or without boat tailing and fins. Slender body theory provides an equation for the sum of the pitching moment derivatives due to pitch rate and due to acceleration in heave that is modified empirically to correlate tunnel and range data extracted from the literature. It involves the normal force curve slope which is obtained from ESDU 89008 with correction from ESDU 87033 for the effect of boat tailing. To obtain the pitch rate derivative, the slender body prediction for the derivative due to acceleration in heave is subtracted from the predicted sum; that requires the pitching moment curve slope also obtained from ESDU 89008 and 87033. For the body alone, predictions are within 20 percent of the experimental values. It is noted that higher values of the acceleration in heave derivative can occur when transition occurs at the base, but values for the sum of the derivatives predicted by ESDU 91004 are conservative and apply when transition is near the pitching axis; this effect does not influence the pitch rate derivative. Range data had a greater scatter than tunnel data and it is suggested that incorrect magnus effect corrections could cause that. A method is suggested for including the effect of fins, which is empirical and based on limited data. It involves modifying the body alone prediction and using ESDU 70012 to obtain the normal force curve slope, ESDU Aero 91007 for body interference, and

ESDU 70012 for the aerodynamic centre of the surfaces. Worked examples illustrate the use of the method and sketches show typical correlations achieved. ESDU

N92-11968 ESDU International Ltd., London (England). **LIFT-CURVE SLOPE OF WING-BODY COMBINATIONS**

Jun. 1991 17 p Supersedes ESDU-Aero-A.S.01.03.01

(ISSN 0141-497X)

(ESDU-91007; ESDU-AERO-A.S.01.03.01; ISBN-0-85679-769-3)

Avail: ESDU

ESDU 91007 discusses missiles in which interference loads make a large contribution because of the small span to body diameter ratio. In this case, an axisymmetric body with midwing is considered at low angles of attack (less than 2 degrees) in subsonic or supersonic flow. The method takes the body alone contribution (ESDU 89008 provides values for forebody cylinders) and adds contributions from the wing (in the presence of the body) and from the change in body lift curve slope due to the wing. Both contributions are obtained by factoring the isolated wing lift curve slope from ESDU 70011 or 70012 (for subsonic supersonic flow respectively). Equations and graphs are given for the factors. The wing factor is a function of span to body diameter ratio, while, at supersonic speeds, the body correction factor depends on whether the Mach line from the wing tip intersects the root chord or passes downstream of its trailing edge. In the latter case the factor is a function of body length downstream of the wing. The method applies to straight or swept forward trailing edges, but has been found satisfactory for moderate trailing edge sweeps. It is found to compare with experiment within about 10 percent. A worked example illustrates the use of the method. ESDU

N92-11969 ESDU International Ltd., London (England). **EFFECT OF TWIN FINS ON ISOLATED TAILPLANE LIFT-CURVE SLOPE**

Jul. 1991 7 p

(ISSN 0141-397X)

(ESDU-91009; ISBN-0-85679-771-5) Avail: ESDU

ESDU 91009 discusses a method that is based on determining the effective (increased) aspect ratio of the tailplane due to the end plate effect of the fins. ESDU 70011 is then used to estimate the lift curve slope for that effective aspect ratio. Wind tunnel data drawn from the literature for a wide range of configurations were used to correlate the effective aspect ratio (determined using ESDU 70011) as a function of the ratio fin height/tailplane span and fin spanwise position. The data were correlated to within 5 percent and applied to straight tapered tailplanes of taper ratio between 1 and 0.4 (tip chord/centerline chord) and mid chord sweep up to 45 degrees, for any fin planform, and are independent of fin vertical location on the tailplane. For swept tailplanes the correlation only applies when the fin chord extends well forward of the tailplane leading edge (by at least 0.25 chord). It is restricted to attached flow at subcritical speeds. The ranges of the geometries for the test data used in the correlation are tabulated, sketches show plots comparing predicted with experimental results, and a worked example illustrates the use of the data. ESDU

N92-11970 ESDU International Ltd., London (England). **MAXIMUM LIFT OF WINGS WITH TRAILING-EDGE FLAPS AT LOW SPEEDS**

Aug. 1991 21 p

(ISSN 0141-397X)

(ESDU-91014; ISBN-0-85679-776-6) Avail: ESDU

A method is given that involves the calculation of two components: the increment in maximum lift coefficient due to flaps is added to the maximum lift coefficient for the wing with flaps undeployed determined from ESDU 89034. The first component is calculated using ESDU 85033 applied to the most highly loaded section, factored for effects of aspect ratio, taper ratio, and wing sweep in addition to flap part span effects. The method was developed using wind tunnel data from many sources for a wide range of planform parameters (aspect ratios from 3 to 9 and leading edge sweep up to 50 degs) for which it was found to correlate the predicted increment generally within 10 pct. and the

maximum lift of the wing with flaps deployed to within 5 pct. It applies for freestream Mach numbers less than 0.25 for plain, split, or single or multi-slotted flaps. Sketches of predictions plotted against test results illustrate the quality of the estimation and a detailed worked example illustrates the use of the method.

ESDU

N92-11972# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de la Physique Générale. **THERMOGRAPHIC GUST WIND TUNNEL MEASUREMENTS Final Report [MESURES THERMOGRAPHIQUES EN SOUFFLERIE A RAFALES. RAPPORT FINAL]** M. GIRARD Aug. 1990 41 p In FRENCH (Contract DRET-BC-87-001-54) (ONERA-RF-31/3409-PY; ETN-91-90087) Avail: CASI HC A03/MF A01

A test campaign at the R3Ch gust wind tunnel using a space plane type model is reported. Information storage problems are discussed. The results are transferred to the French aerodynamic management (OA) in magnetic tape form. Additionally, the image inventory analysis methods are transferred to the OA. ESA

N92-11973# Technische Univ., Eindhoven (Netherlands). Vakgroep Transportfysica.

ON THE LIMITATIONS OF FROUDE'S ACTUATOR DISC CONCEPT Ph.D. Thesis

GIJSBERTUS ARNOLDUS VANKUIK 1991 151 p (ETN-91-90136) Avail: CASI HC A08/MF A02

The question of whether the actuator disc including edge forces is a better representation of the action of conventional helicopter or wind turbine rotors than Froude's mathematical model is addressed. The load on the chordwise bound vorticity of the rotor blade is shown not to perform work, which conflicts with Froude's assumption of the load converting power being equal to the total load. An experiment on a model rotor in hover shows the load converting power to be smaller than the total load on the rotor. It is concluded that the addition of edge forces to Froude's concept improves the performance prediction for rotors significantly, although discrepancies between prediction and measurement remain. The actuator disc itself is addressed and the question of whether the edge forces are an inherent part of the load instead of merely an addition to Froude's concept is addressed numerically and analytically to improve the representation of real rotors. A nonlinear viscous finite element calculation is set up for the flow of a two dimensional actuator strip with a smooth load distribution. ESA

N92-11978# Laboratoire d'Aerothermique du CNRS, Meudon (France).

COMPRESSION RAMP IN RAREFIED GAS Final Report [RAMPE DE COMPRESSION EN GAZ RAREFIE. RAPPORT FINAL]

J. C. LENGREND, K. S. HEFFNER, and A. CHPOUN Dec. 1990 70 p In FRENCH (Contract DRET-89-34-080-00-47075-01) (RC-90-08; ETN-91-90100) Avail: CASI HC A04/MF A01

Comparisons are made between the Direct Simulation Monte Carlo (DSMC) method, the results obtained using Navier-Stokes equations, and experimental results, in terms of their ability to predict the thermodynamics of atmospheric entry by a spacecraft. The experimental results used are those obtained using a SR3 wind tunnel. A compression ramp is placed within a supersonic flow. The compression ramp is modeled after the tail section of the Space Shuttle. The experiments are carried out at a flow rate of Mach 4 in moderately rarified gas and at Mach 20.2 in a very rarified gas environment. ESA

N92-11979# Laboratoire d'Aerothermique du CNRS, Meudon (France).

FLAT PLANES IN RAREFIED HYPERSONIC FLOWS Final Summary Report [PLAQUES PLANES PLACÉES EN ÉCOULEMENTS HYPERSONIQUES RAREFIÉS. RAPPORT FINAL DE SYNTHÈSE]

J. ALLEGRE (Centre National de la Recherche Scientifique, Meudon-Bellevue (France)), M. RAFFIN, J. C. LENGREND, A. CHPOUN, and L. GOTTESDIENER (Paris VI Univ., France) Jan. 1991 82 p In FRENCH (Contract DRET-88-251) (SESSIA-430/91-940; ETN-91-90101) Avail: CASI HC A05/MF A01

Experimental density fields measured in wind tunnel tests are compared with the density fields calculated by means of Monte Carlo and Navier-Stokes methods. Extra wind tunnel tests measuring heat flux and wall pressures are needed to be able to compare the experimental values with values calculated using the Direct Simulation Monte Carlo (DSMC) and Navier-Stokes equations. The results of the tests are presented in full. ESA

N92-11980# Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers (France). Lab. d'Aérodynamique.

NONSTATIONARY FLIGHT AERODYNAMICS IN A TURBULENT ENVIRONMENT Final Summary Report [AÉRODYNAMIQUE INSTATIONNAIRE DU VOL EN MILIEU TURBULENT. RAPPORT DE SYNTHÈSE FINAL]

P. ARDONCEAU and F. MICHEL Jul. 1990 72 p In FRENCH (Contract DRET-85-072)

(ETN-91-90102) Avail: CASI HC A04/MF A01

Experimental results of wind tunnel tests on a rectangular wing panel and on a half delta wing submitted to oscillations are described. Charts of nonstationary wing pressures, of flow deflection at the trailing edge of the wing and visualizations of the wing wake are presented. A second series of tests carried out on a flying scale model of the Rafale aircraft are described. The wing pressures and local flow over the wing are quantified for flight close to the ground and in meteorologically perturbed conditions. The results of these tests are presented. ESA

N92-11981# Centre d'Etudes Aérodynamiques et Thermiques, Poitiers (France).

CONTROL ASPECTS OF THE TRANSITION FROM TRANSVERSAL TO TRANSONIC FLOW, STEP EFFECTS Final Report [CONTROLE DE LA TRANSITION TRANSVERSALE EN TRANSSONIQUE PAR ASPIRATION: EFFET DE MARCHES. RAPPORT FINAL]

R. LEBLANC and H. GAREM Dec. 1990 19 p In FRENCH (Contract DRET-89-1170)

(ETN-91-90106) Avail: CASI HC A03/MF A01

Transonic wind tunnel tests are used to study transitions along an arrowhead shaped wing and the control of this wing by suction along its leading edge. The effects of ascendent and descendent steps is considered. The goal of the research is that of delaying the laminar surface layer transitions triggered by the transverse pressure gradient in order to reduce the viscous trail of the airplanes, thus reducing their overall operating costs and increasing their operating range. The wind tunnel tests carried out in a scale model of an arrowhead shaped wing indicate that step effects lead to too much flow perturbation over the wing. ESA

N92-11982# Institut de Mécanique des Fluides de Lille (France).

PHENOMENOLOGICAL MODELING OF THE WAKE PRODUCED BY A STRAIGHT TWO DIMENSIONAL BASE IN SUBSONIC FLOW [MODÉLISATION PHÉNOMÉNOLOGIQUE DU SILLAGE D'UN CULOT DROIT BIDIMENSIONNEL EN ÉCOULEMENT SUBSONIQUE]

O. RODRIGUEZ 21 Dec. 1990 59 p In FRENCH (Contract DRET-89-003-07)

(REPT-90/59; ETN-91-90109) Avail: CASI HC A04/MF A01

Wake turbulence phenomena at subsonic speeds are studied. The aerodynamic phenomena leading to detachment and large spinning structures in wakes is given particular attention. A better understanding of these phenomena is needed to comprehend wake reduction measures and jet homogenization techniques. The results of numerous wind tunnel tests are presented. They show that the

02 AERODYNAMICS

development of spinning eddies of turbulence is similar no matter the height of the base or the Reynolds or Mach number involved.
ESA

N92-12996# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.

VORTEX FLOW AERODYNAMICS

Jul. 1991 537 p In ENGLISH and FRENCH Symposium held in Scheveningen, Netherlands, 1-4 Oct. 1990

(AGARD-CP-494; ISBN-92-835-0623-5; AD-A244249) Copyright

Avail: CASI HC A23/MF A04

The AGARD Fluid Dynamics Panel sponsored this symposium to provide an update review of the aerodynamic effects of separation-induced vortex flows on the design and off-design performance of fighter aircraft. A better understanding is needed to predict and control these vortex flows throughout the flight envelope at subsonic, transonic, and supersonic speeds, and especially during high lift operations for take-offs, landings, and sustained and instantaneous maneuvers. Topics of interest included vortex development and burst, modeling and validation of the full range of analytic methods, slender-body vortex flows at high angles of attack, vortex control and management, and unsteady vortex flow effects. In addition to the symposium papers, the results of the round table discussion are presented.

N92-12997# National Aerospace Lab., Amsterdam (Netherlands).

MODELING AND NUMERICAL SIMULATION OF VORTEX FLOW IN AERODYNAMICS

H. W. M. HOEIJMAKERS In AGARD, Vortex Flow Aerodynamics 46 p Jul. 1991 Sponsored in part by the Netherlands Agency for Aerospace Programs (NIVR) for the Netherlands Ministry of Defence

(AD-B163670L) Copyright Avail: CASI HC A03/MF A04

A review is presented of mathematical models of different levels of approximation and their application to the numerical simulation of vortical flows occurring in subsonic and transonic aircraft aerodynamics. Computational methods for predicting the downstream development of vortex wakes are covered as well as methods for simulating the detailed characteristics of configurations with leading-edge or body vortices. The emphasis is on the later, strong-interaction type of vortical flows. Promising developments related to presently used methods are discussed in some detail. The possibilities, limitations, and prospects for improving the methods are indicated and results of various methods are discussed. Also considered are some more fundamental aspects of the numerical simulation of phenomena such as separation at sharp and round leading edges, separation at a smooth part of a surface, the structure of the leading-edge vortex, and the merging of two vortices.
Author

N92-12998# Royal Aircraft Establishment, Farnborough (England).

COMPARISON OF SOLUTION OF VARIOUS EULER SOLVERS AND ONE NAVIER-STOKES SOLVER FOR THE FLOW ABOUT A SHARP-EDGED CROPPED DELTA WING

B. R. WILLIAMS, W. KORDULLA, M. BORSI, and H. W. M. HOEIJMAKERS In AGARD, Vortex Flow Aerodynamics 12 p Jul. 1991 Previously announced as N91-30106 Sponsored in part by the Ministry of Defence, England; German Ministry of Defence; Italian Ministry of Defence; and the Netherlands Agency for Aerospace Programs for the Ministry of Defence

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For the flow about a sharp-edged cropped 65-deg delta wing numerical solutions obtained with different Euler methods are compared with each other, with the numerical solution of a Reynolds-averaged Navier-Stokes method, and with experimental data. At the selected free-stream Mach number of 0.85 and angle of attack of 10 deg the flow features a leading-edge vortex, is transonic, but contains weak shocks only. The results of the Euler methods have been obtained on one and the same C-H type of grid with close to 300,000 cells. This investigation, carried out

within the framework of a four-nation collaborative program, indicates that for the test case considered there are, from a theoretical point of view, significant differences between results from different Euler methods, even if artificial dissipation is minimized. However, the correlation of the Euler solutions with experimental data shows much larger differences due to the failure to represent secondary separation in the Euler methods and is therefore unsatisfactory. The results of the Reynolds-averaged Navier-Stokes method demonstrate an improved correlation of theory and experiment.
Author

N92-12999# Aeritalia S.p.A., Turin (Italy).

VORTICAL FLOW SIMULATION BY USING STRUCTURED AND UNSTRUCTURED GRIDS

M. BORSI, L. FORMAGGIA, E. HETTENA, S. SANTILLAN, V. SELMIN, and S. TARDITI In AGARD, Vortex Flow Aerodynamics 12 p Jul. 1991 Previously announced as N91-30107

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Two Euler equation solvers based on finite volume formulations on structured and unstructured grids are applied to the simulation of transonic vortical flow around a delta wing-body configuration. The mesh generation techniques are described, some details on the flow solvers are given, and a comparison between the methods is presented.
Author

N92-13000# National Aerospace Lab., Amsterdam (Netherlands).

ANALYSIS OF RESULTS OF AN EULER-EQUATION METHOD APPLIED TO LEADING-EDGE VORTEX FLOW

J. I. VANDENBERG, H. W. M. HOEIJMAKERS, and J. M. J. W. JACOBS In AGARD, Vortex Flow Aerodynamics 12 p Jul. 1991 Sponsored in part by the Netherlands Agency for Aerospace Programs (NIVR) for the Netherlands Ministry of Defence

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The flow about a 65-deg sharp-edged cropped delta wing with and without an under-wing body is simulated by solving the Euler equations. Results are presented for the wing-body configuration at a transonic free-stream Mach number at incidences ranging from 10 to 20 deg for which in the flow field above the wing a strong vortex develops as well as shocks for the high incidence of 20 deg. Results for subsonic to transonic free-stream Mach numbers at high incidence are obtained for the wing-alone configuration for which in the presence of a strong vortex, at transonic free-stream Mach number, shocks appear in the solution. For the wing-body configuration, the computational results are compared with experimental data, and the solution in the near wake is investigated.
Author

N92-13001# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE VORTEX FLOW OVER A DELTA WING AT TRANSONIC SPEED

E. M. HOUTMAN and W. J. BANNINK In AGARD, Vortex Flow Aerodynamics 11 p Jul. 1991

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The flow around a sharp-edged delta wing with 65-deg sweep and a flat upper surface was investigated experimentally as well as numerically. The experimental program consisted of surface pressure measurements, oil flow visualization, and flow field explorations at Mach numbers 0.60 and 0.85 and angles of attack up to 20 deg. The results show a transonic leeward flow structure with several shock waves. At a Mach number of 0.85 and 20 deg angle of attack vortex breakdown is observed. The vortex breakdown goes along with a double shock system in the symmetry plane region. In the numerical program a 3D Euler code is used with two upwind schemes; one of the flux-splitting type and one of the flux-difference-splitting type. The results show significant differences between the two discretization schemes, in particular in the region of the vortex. Between computations and experiments large differences are observed due to the absence of secondary separation, and, at the higher angles of attack, due to the absence of vortex breakdown in the computations.
Author

N92-13003# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany).
ON THE SIMULATION OF COMPRESSIBLE TURBULENT FLOWS PAST DELTA WING, DELTA WING-BODY AND DELTA WING-CANARD

ACHIM HILGENSTOCK and HEINRICH VOLLMERS *In* AGARD, Vortex Flow Aerodynamics 13 p Jul. 1991
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The turbulent flow around a delta wing at incidence is simulated numerically using a finite volume Navier-Stokes method. The numerical simulation makes use of a simple algebraic turbulence model. Using a sharp leading edge delta wing, the influence of grid refinement is investigated. A realistic wing-body configuration with a round leading edge is used to discuss the influence of the position of the transition line. Experimental and numerical data are compared to validate the numerical method. The topological structure of the flow is discussed. An explanation is given for the low particle density area close to the primary vortex as it is visualized by the laser light sheet technique. First results for a closed coupled delta-wing-canard configuration are also discussed.

Author

N92-13005# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany).
ON THE FOOTPRINTS OF THREE-DIMENSIONAL SEPARATED VORTEX FLOWS AROUND BLUNT BODIES: ATTEMPTS OF DEFINING AND ANALYZING COMPLEX FLOW STRUCTURES

UWE DALLMANN, ACHIM HILGENSTOCK, STEFAN RIEDELBAUCH, BURKHARD SCHULTE-WERNING, and HEINRICH VOLLMERS *In* AGARD, Vortex Flow Aerodynamics 13 p Jul. 1991

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An analysis of vortex flows around different configurations in very different Mach and Reynolds regimes is presented. Subsonic, transonic, and hypersonic separated flows are considered. The common interest was to study the relationships between the topologies of steady or unsteady, two dimensional or three dimensional separated vortex flow structures and their footprints which they leave on the boundaries (walls) or within any section across the flow field. From this point of view numerical Navier Stokes simulations are analyzed in the following respect: Topological changes of the instantaneous sectional streamlines and the skin friction patterns of incompressible flows are considered during vortex shedding and during onset of three dimensionality of the flow. Two dimensional separation bubbles, separation from a cylinder in crossflow, and separation from a sphere are analyzed. The formation of vortex cores and their relationship to so called open or closed flow separation, wall vorticity, wall pressure, wall heat flux, and various sectional flow data are investigated in compressible flows such as the transonic transitional flow around a round edged delta wing and the hypersonic laminar flow around a double ellipsoid.

Author

N92-13008# Royal Aircraft Establishment, Farnborough (England).
REVIEW OF AIRCRAFT DYNAMIC LOADS DUE TO FLOW SEPARATION

D. G. MABEY *In* AGARD, Vortex Flow Aerodynamics 10 p Jul. 1991

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A detailed review of the 70th meeting of the Advisory Group for Aerospace Research and Development (AGARD) Structures and Materials Panel, prepared for the AGARD Fluid Dynamics Panel, is presented. Accordingly emphasis is placed on the aerodynamic information presented, rather than the structural aspects. Experimental results and computations are described for flows with bubble and vortex separations. Some conclusions are drawn and recommendations are made for further research. In particular, the review suggests that much greater attention should be given to establishing the magnitude of possible scale effects (both in experiments and calculations) and to the prediction of fin buffeting.

Author

N92-13010# Technische Univ., Brunswick (Germany).

VORTEX FORMATION OVER A CLOSE-COUPLED CANARD-WING-BODY CONFIGURATION IN UNSYMMETRICAL FLOW

A. BERGMANN, D. HUMMEL, and H.-CHR. OELKER (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* AGARD, Vortex Flow Aerodynamics 14 p Jul. 1991
 (Contract DFG-HU-254/8)

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A close coupled canard wing body combination was investigated in unsymmetrical flow. The configuration consisted of a delta canard, a delta wing, and a body of revolution as the fuselage. Six component and surface pressure distribution measurements as well as flow visualizations by means of the laser lightsheet technique were carried out at Reynolds numbers (based on wing inner chord) of $Re = 1.1 \times 10^6$ and $Re = 1.4 \times 10^6$ for the canard-off and the canard-on configuration. For large angles of attack distinct jumps of the aerodynamic coefficients have been detected in unsymmetrical flow which are due to sudden changes of the flow structure. In the canard-off configuration they are caused by the collapse of the vortex type flow on the windward side of the configuration into a deadwater type flow which takes place when the vortex breakdown position within the wing vortices reaches the wing apex. In the canard-on configuration the sensitive and favorable interference between canard and wing is suddenly disturbed. Apart from a small region in the vicinity of the symmetrical flow in which a vortical flow at the canard can be maintained up to extremely large angles of attack, in unsymmetrical flow at high angles of attack the flow over the windward side of the canard collapses from a vortex type flow to a deadwater type flow due to a sudden loss of favorable interference, and this causes the jumps in the slope of the aerodynamic coefficients.

Author

N92-13011# National Aerospace Lab., Amsterdam (Netherlands).

AN EXPERIMENTAL STUDY OF THE FLOW OVER A SHARP-EDGED DELTA WING AT SUBSONIC AND TRANSONIC SPEEDS

A. ELSENAAR and H. W. M. HOEIJMAKERS *In* AGARD, Vortex Flow Aerodynamics 19 p Jul. 1991 Sponsored in part by the Netherlands Agency for Aerospace Program (NIVR) for the Netherlands Ministry of Defence

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The flow about a sharp edged cropped delta wing is investigated experimentally. The experiment comprised detailed surface pressure measurements at low subsonic, transonic, and low supersonic freestream Mach numbers for angles of attack up to 27 deg. The major part of the measurements were carried out at a Reynolds number of 9 million, but some data was also obtained at lower and higher Reynolds numbers. The investigation included continuous schlieren flow field visualization as well as surface flow visualizations at a limited number of free stream conditions. The analysis of the measured data embraced flow field phenomena such as primary separation and the formation of the leading edge vortex, secondary separation and the formation of the secondary vortex, shock waves, and the onset of vortex breakdown. Considered are the influence of Mach number, incidence, and Reynolds number on these flow features.

Author

N92-13012# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Aerothermodynamique.
CHARACTERISTICS OF A BOUNDARY LAYER IN A LEADING EDGE VORTEX [CARACTERISTIQUES D'UNE COUCHE LIMITE EN AVAL D'UN TOURBILLON DE BORD D'ATTAQUE]

G. PAILHAS and J. COUSTEIX *In* AGARD, Vortex Flow Aerodynamics 17 p Jul. 1991 *In* FRENCH; ENGLISH summary

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The boundary layer developing downstream of a leading edge vortex was investigated. This experiment is devoted to the understanding of the behavior of such a boundary layer submitted to the effects of a leading edge vortex developing on the suction

side of a swept wing. The infinite swept wing considered for the present study is mounted between the top and the bottom walls of the test section at a sweep angle of 60 degrees and at an incidence of 15 degrees. The airfoil is symmetric and has a maximum thickness ratio of .1 and a chord length of 200 mm; it is an ONERA D airfoil, that is, a peaky-type airfoil. Mean and turbulent velocity profile surveys were carried out in various positions located downstream of the reattachment line, but also for a few positions in the vortex core by means of hot wire anemometry. Measurements in the vortex core and in the boundary layer were made by using respectively a four and single hot wire probe. Author

N92-13013# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

VORTEX FLOW ON A MISSILE BODY: EXPERIMENTAL STUDY AND MODELING [ECOLEMENT TOURBILLONNAIRE SUR FUSELAGE DE MISSILE ETUDE EXPERIMENTALE ET MODELISATION]

P. CHAMPIGNY and D. BAUDIN /in AGARD, Vortex Flow Aerodynamics 9 p Jul. 1991 In FRENCH; ENGLISH summary Previously announced in IAA as A91-16738 Copyright Avail: CASI HC A02/MF A04

The vortex flowfield around a missile body was investigated in the ONERA S2MA wind tunnel in order to predict missile aerodynamic characteristics. For angles of attack up to 20 degrees and Mach numbers ranging from 0.8 to 3.0, five-hole probe measurements give the local characteristics of the flow, e.g., transverse velocity vectors, local Mach numbers, and stagnation pressures. The position, strength, and core radius of the vortices are analyzed and a modeling of the flowfield based on viscous vortices is described. Applications of this model to missile aerodynamics show the need to take the nose vortices into account in engineering methods for good performance predictions. Author

N92-13014# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

ASYMMETRIC VORTEX FLOW OVER CIRCULAR CONES

M. PIDD and J. H. B. SMITH /in AGARD, Vortex Flow Aerodynamics 11 p Jul. 1991 Copyright Avail: CASI HC A03/MF A04

Presented here is an update on earlier Royal Aerospace Establishment (RAE) work on the formation of asymmetric vortices from slender pointed bodies at large angles of incidence. The emphasis is on theoretical and experimental work on flow over circular cones. For a single line vortex model of asymmetric conical flow over circular cones with symmetric separation lines, a thorough exploration of parameter space revealed only insignificant regions of multiple solutions and no further bifurcation locus from which asymmetric solutions could arise. An examination of the stability of solutions of this model to small spatial disturbances has shown that stable symmetric solutions are confined to a narrow band of values of the incidence parameter, but that, with insignificant exceptions, the asymmetric solutions are stable. An examination of low speed experimental data shows that asymmetric flow over a circular cone can be significantly non-conical with large variations in local side force coefficient along the length of the cone. At an angle of incidence of 35 degrees on a 10 degree cone, the approximately conical flows appear to predominate, but at 30 degrees they only occur exceptionally. Author

N92-13015# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF FINENESS RATIO ON LATERAL FORCE ON A POINTED SLENDER BODY OF REVOLUTION

I. R. M. MOIR /in AGARD, Vortex Flow Aerodynamics 13 p Jul. 1991 Copyright Avail: CASI HC A03/MF A04

Tests were made on a slender body model in the Royal Aerospace Establishment (RAE) Farnborough 5 meter pressurized low speed wind tunnel. Measurements of side force variation with

angle of incidence and with roll angle are presented, together with an examination of the angle of incidence at which side force onset occurs and how this varies with nose apex angle, overall fineness ratio, and Reynolds number. A flow visualization technique was used to study the development of vortical symmetry as angle of incidence was increased. Author

N92-13018# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

DETERMINATION OF VORTEX-BREAKDOWN CRITERIA BY SOLVING THE EULER AND NAVIER-STOKES EQUATIONS [DETERMINATION DE CRITERES D'ECLATEMENT TOURBILLONNAIRE PAR RESOLUTION DES EQUATIONS D'EULER ET DE NAVIER STOKES]

T. H. LE, PH. MEGE, and Y. MORCHOISNE /in AGARD, Vortex Flow Aerodynamics 10 p Jul. 1991 In FRENCH; ENGLISH summary Previously announced in IAA as A91-26081 Copyright Avail: CASI HC A02/MF A04

A parametric study based on numerical simulations which solve Euler and Navier-Stokes equations is performed on the configuration of an isolated vortex subjected to an initial perturbation. An analysis of the vortex breakdown characteristics indicates that the phenomenon appears abruptly, that it is three dimensional and unsteady by nature, and that the turbulence is characterized by small-scale structures that are established at a specified moment. This analysis permits a criterion to be specified that is based on an appropriately defined local Rossby number to determine the area where breakdown occurs. Author

N92-13021# Technische Univ., Aachen (Germany). Dept. of Aerospace Engineering.

ON AIRCRAFT WAKE PROPERTIES AND SOME METHODS FOR STIMULATING DECAY AND BREAKDOWN OF TIP VORTICES

R. STAUFENBIEL and T. VITTING /in AGARD, Vortex Flow Aerodynamics 14 p Jul. 1991 Sponsored in part by Deutsche Forschungsgemeinschaft (DFG) Copyright Avail: CASI HC A03/MF A04

Investigations on the formation and structure of wing tip vortices are presented. A computational method for the time-dependent roll-up process is derived, which is based on the Biot-Savart approach with a particular technique of amalgamation which preserves energy, center of vorticity, and the second moment of vorticity distribution. The results are compared with laser Doppler velocimeter (LDV) measurements performed in a water tunnel. The influence of lift distribution on maximum circumferential velocity of trailing vortices is investigated. Moreover, some special devices for vortex wake alleviation were experimentally investigated in order to reveal the potential of three methods for vortex wake alleviation: (1) artificially destabilizing the vortex; (2) inducing breakdown of the vortex core; and (3) spreading and splitting the vorticity of trailing vortices. Author

N92-13022# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

CONTROL OF FOREBODY VORTICES BY SUCTION AT THE NOSE OF THE RAE HIGH INCIDENCE RESEARCH MODEL

A. JEAN ROSS and E. B. JEFFERIES /in AGARD, Vortex Flow Aerodynamics 9 p Jul. 1991 Copyright Avail: CASI HC A02/MF A04

The concept of applying suction at the nose of forebodies at high angle of attack to control the vortex flow was applied in static and dynamic wind tunnel tests on the RAE High Incidence Research Model. The first series of static tests showed that sideforce and yawing moment varied nearly linearly with the flow rate (or mass flow) coefficient, rather than the momentum coefficient, up to a maximum, but the maximum control powers available were small on the original drooped forebody. The results for suction on a large ogival forebody give yawing moment equivalent to about 25 degrees of rudder at an angle of attack of 30 degrees, and significantly higher for higher angles. They also show some dependence on whether separation is laminar or turbulent, and parameters defining the variation with flow rates

are compared. Dynamic experiments on a free-to-yaw rig, with active control of flow rates, were inconclusive and further experiments are being conducted. Author

N92-13023# Royal Aircraft Establishment, Farnborough (England).

AN EXPERIMENTAL INVESTIGATION OF VORTEX FLAPS ON A CANARD COMBAT-AIRCRAFT CONFIGURATION

D. A. LOVELL /in AGARD, Vortex Flow Aerodynamics 11 p Jul. 1991

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A low-speed wind tunnel investigation of two vortex-flap configurations fitted to a canard-delta combat-aircraft research model having a 53 degree sweep wing is reported. The effect of foreplane interference and vortex-flap geometry on the aerodynamic performance of the vortex flaps is determined. It is concluded that vortex flaps can generate large gains in trimmed lift and lift to drag ratio, particularly when used in conjunction with trailing-edge flaps. Author

N92-13027# Technical Univ. of Istanbul (Turkey). Faculty of Aeronautics and Astronautics.

NUMERICAL SIMULATION OF VORTEX STREET-EDGE INTERACTION

M. O. KAYA (Istanbul Univ. (Turkey)), C. R. KAYKAYOGLU (Istanbul Univ. (Turkey)), K. C. BAYAR (Istanbul Univ. (Turkey)), and J. M. R. GRAHAM (Imperial Coll. of Science and Technology, London, England) /in AGARD, Vortex Flow Aerodynamics 12 p Jul. 1991

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Preliminary results and computational method reviews are presented for the simulation of a vortex street impinging on three different leading edge geometries of sharp, blunt, and elliptic type, making use of Lagrangian and mixed Lagrangian-Eulerian vortex methods. Two new computer codes were developed to capture the essential features of the interaction mechanism near the edge surface. The first method utilizes a Discrete Vorticity Method (DVM) where a fixed Eulerian mesh system is needed to move the vortices through the flow domain. A more advanced computer model of the full Navier-Stokes equations of motion combines the Lagrangian convection and Eulerian diffusion schemes and is called the Hybrid Moving Vortex Diffusive Method (HMVDM). An unsteady shear layer flow arising from boundary layer separation at a bluff trailing edge creates the downstream vortex street. The models simulate most features of the impingement including the secondary vortex shedding as a truly self-generated phenomenon arising from impingement of the large-scale incident disturbances. The approaching vortex street is affected by the diverging flow around the elliptic edge. Vortex impingement on a blunt edge causes the most complex features of the interaction. The unsteady pressure distributions agree with the common observations. Author

N92-13028# Politecnico di Milano (Italy). Dipt. di Ingegneria Aerospaziale.

NUMERICAL SIMULATION OF VORTEX FLOWS PAST IMPULSIVELY STARTED WINGS

A. BARON, M. BOFFADOSI, and S. DEPONTE /in AGARD, Vortex Flow Aerodynamics 14 p Jul. 1991

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A nonlinear unsteady vortex lattice method is used to predict the geometry of the wakes and the distribution of the aerodynamic loads on impulsively started wings. The wings are assumed to have negligible thickness, arbitrary aspect ratio, and planform. They can undergo a general unsteady motion. Multi-wing configurations can be treated. Wakes can be released in the flowfield from any of the sharp edges of the lifting surfaces, depending on planform, aspect ratio, and attitude of the wings. Particular emphasis is placed on the simulation of vortex core diffusion which is regarded as a prominent factor in a correct development of unsteady wakes. A vortex core diffusion model is proposed which seems to be able to deal even with the severe roll-up of the shear layers past highly swept multi-wing configurations with leading edge separation.

The prediction capabilities of the method are verified by comparison of the numerical results with experimental data published by various authors. Author

N92-13951*# Deutsche Airbus G.m.b.H., Bremen (Germany). Dept. of Aerodynamics.

APPLICATION OF DIRECT INVERSE ANALOGY METHOD (DIVA) AND VISCOUS DESIGN OPTIMIZATION TECHNIQUES

E. GREFF, D. FORBRICH, and H. SCHWARTEN /in Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 307-324 1991

Avail: CASI HC A03/MF A06

A direct-inverse approach to the transonic design problem was presented in its initial state at the First International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-1). Further applications of the direct inverse analogy (DIVA) method to the design of airfoils and incremental wing improvements and experimental verification are reported. First results of a new viscous design code also from the residual correction type with semi-inverse boundary layer coupling are compared with DIVA which may enhance the accuracy of trailing edge design for highly loaded airfoils. Finally, the capabilities of an optimization routine coupled with the two viscous full potential solvers are investigated in comparison to the inverse method. Author

N92-14004# Technische Univ., Delft (Netherlands). Low Speed Aerodynamics Lab.

LDA MEASUREMENTS IN THE HIGHLY ASYMMETRIC TRAILING EDGE FLOW OF AN NLR 7702 AIRFOIL

L. H. J. ABSIL and D. M. PASSCHIER Dec. 1990 26 p

Sponsored in part by NLR, Amsterdam, Netherlands (LR-646; ETN-92-90416; PB92-133180) Avail: CASI HC A03/MF A01

Results of detailed LDA (Laser Doppler Anemometry) measurements performed in the vicinity of the trailing edge of a supercritical NLR 7702 airfoil are presented. The two dimensional model, put at an angle of attack of 4 degrees, was tested at a Mach number of 0.1 and a Reynolds number of 1,500,000. Under these conditions the upper surface boundary layer is close to separation at the trailing edge. Downstream of the trailing edge, both shear layers merge together into a strongly curved, highly asymmetric near wake. In the boundary layers and in the near wake, distributions of the longitudinal and transverse mean velocity, turbulence normal and shear stresses, Skewness and Kurtosis factors were measured. The main objective of this investigation was to provide detailed and reliable mean velocity and turbulence data for development of turbulence closure models for trailing edge flows and validation of computational methods. ESA

N92-14973# European Space Agency, Paris (France).

AEROTHERMODYNAMICS FOR SPACE VEHICLES

B. BATTRICK, ed. Jul. 1991 570 p In ENGLISH and FRENCH The 1st European Symposium was held in Noordwijk, Netherlands, 28-30 May 1991; sponsored by ESTEC, AAF/CNES and DGLR/DARA/DLR

(ESA-SP-318; ISBN-92-9092-114-5; ETN-92-90680) Copyright

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Papers concerning the development of aerothermodynamics for space vehicles, covering problems of high speed flight for advanced launchers, reentry vehicles and planetary landers are presented. The focus of the symposium was the new technology of 'aerothermodynamics', which includes classical aerodynamics, thermodynamics, and thermochemistry. The applications presented and discussed covered external flow over vehicles and internal flow through vehicle propulsion systems, at speeds ranging from the low subsonic, through transonic, to supersonic and hypersonic. The flight trajectories addressed included ascent to space from planetary surfaces, descent from space to planetary surfaces, flight

through low density atmospheres, and aerobraking by atmospheric entry.

ESA

N92-14974# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Propulsion and Aerothermodynamics Div.

AEROTHERMODYNAMIC CHALLENGES FOR ESA PROGRAMMES

W. BERRY *In its Aerothermodynamics for Space Vehicles* p 3-10 Jul. 1991

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A history of aerothermodynamic activities in the European Space Research Organization/European Space Agency (ENRO/ESA) is given. Between 1964 and 1988 these were devoted to satellite aerodynamics for low Earth orbit missions and rocket engine exhaust plume dynamics. The creation of an aerodynamic capability at the European Space Research and Technology Center (ESTEC) is mentioned, and the programs involving substantial aerothermodynamics are listed. The aerothermodynamic challenges for future ESA mission in its science, Earth observation, and space transportation programs, are addressed, and design solutions offered. Within the science programs the Cassini/Huygens, Rosetta, and Mars missions are considered. Within the Earth observation programs the Aristoteles mission is considered. Within the space transportation programs, Ariane-5, Hermes, and reusable winged launchers are considered. Design tools and engineering facilities needed for modern aerothermodynamics are discussed; ESA's research and development activities in aerothermodynamics are addressed. One of these activities is to prepare and implement a Technology Research Program (TRP) designed to prepare the technology needed for Europe's space program. Activities in progress or planned within the TRP are addressed. They include development of Navier-Stokes algorithms, work in aerothermochemistry effects in hypersonic flows, work on parallel processing for aerothermodynamics, transition criteria in hypersonic flows, and work on measurement techniques in hypersonic flows.

ESA

N92-14978# Saab-Space A.B., Linköping (Sweden). Aircraft Div.

VALIDATION OF A COMPUTATIONAL METHOD FOR LAMINAR HYPERSONIC FLOW AROUND BLUNT BODIES AND THE APPLICATION TO THE FULL HERMES SPACECRAFT

BENGT WINZELL *In ESA, Aerothermodynamics for Space Vehicles* p 51-59 Jul. 1991 Sponsored in part by Avions Marcel Dassault

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An investigation of a Navier-Stokes method for predicting heat loads on blunt bodies in hypersonic flight is presented. Grid density, temperature gradient monitoring and outflow boundary treatment are discussed. Examples of testcase computations and full vehicle simulation are given, using both perfect gas aerodynamics and high temperature equilibrium assumptions.

ESA

N92-14981# Aeronautical Research Inst. of Sweden, Bromma. HYPERSONIC FLOW PAST DELTA WING FLOW SIMULATED BY NAVIER-STOKES SOLUTIONS

S. SRINIVASAN, P. ELIASSEN, and A. RIZZI *In ESA, Aerothermodynamics for Space Vehicles* p 73-78 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Numerical simulations for the laminar hypersonic flow past a blunt edged delta wing were performed by solving the Navier-Stokes equations. These simulations were performed for four different angles of attack: 0, 15, 25, and 30 degrees. The Navier-Stokes equations were solved using the explicit finite volume-four stage Runge-Kutta scheme. The intent is to reach a reasonable understanding of the computed flow fields, including flow separation, shear layers, vortices, shock waves, and entropy losses, and also to study the effect of the angle of attack on the flow features. It was observed that in the case of blunt edged delta

wings at high angles of attack, the hypersonic flow is dominated by a shear layer that separates just past the blunt leading edge forming a more distributed vortical region over the wing, rather than a concentrated vortex structure as observed at lower speeds. The solutions are analyzed and compared with available experimental data. The computed results agree qualitatively with the experimental data but not quantitatively.

ESA

N92-14985# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. for Experimental Fluid Mechanics.

SIMULATION REQUIREMENTS FOR RCS PLUME: FLOWFIELD INTERACTION MODELLING ON A WINGED REENTRY VEHICLE

T. POERTNER *In ESA, Aerothermodynamics for Space Vehicles* p 101-106 Jul. 1991 Sponsored by CNES

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During the initial phase of reentry, the control over a winged vehicle is to be achieved by the Reaction Control System (RCS). For reasons of safety and performance, the reliable prediction of the actual efficiency of a planned RCS configuration is necessary. For the realistic configuration, the interference flowfield is so complex that extrapolations from either existing realistic or too greatly simplified configurations will not yield reliable quantitative prediction of RCS efficiency. As the problem is not accessible to theoretical analysis, efforts should be focused on experimental investigations using realistic models of the intended configurations. For this purpose, simulation requirements are derived based on Shuttle related NASA experience.

ESA

N92-14986# Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. of Hydraulic Machines and Fluid Mechanics.

A MULTIBLOCK FLOW SOLVER FOR INVISCID HYPERSONIC FLOWS

JAN B. VOS (Ecole Polytechnique Federale de Lausanne (Switzerland).) and C. M. BERGMAN (Royal Inst. of Tech., Stockholm, Sweden) *In ESA, Aerothermodynamics for Space Vehicles* p 109-114 Jul. 1991 Sponsored in part by Commission Suisse d'Encouragement des Recherches Scientifiques

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The development of multiblock flow solvers on structured grids is considered. The present version of the solver solves the three dimensional Euler equations for transonic, supersonic, and hypersonic flows. The Euler equations are solved by the finite volume method using a space centered, explicit time marching scheme augmented by artificial dissipation terms. Equilibrium and nonequilibrium air chemistry were implemented. The multiblock solver is written on top of the MEL-COM data base system, and uses a dynamic memory manager to allocate the storage for the variables in each block. Results of multiblock calculations for the flow over a wedge and of single block calculations for the flow around the Hermes Manned Spaceplane at 76 km altitude are presented.

ESA

N92-14987# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. for Design Aerodynamics. STEPS TOWARDS AN EFFICIENT AND ACCURATE METHOD SOLVING THE EULER EQUATIONS AROUND A RE-ENTRY CONFIGURATION AT SUPER- AND HYPERSONIC SPEED

J. SCHOENE, T. STREIT, and N. KROLL *In ESA, Aerothermodynamics for Space Vehicles* p 115-120 Jul. 1991 Sponsored in part by CNES

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Modifications and extensions of a Euler code which enable efficient computations of accurate solutions for supersonic and moderate hypersonic flows are described. These modifications involve a more robust central spatial discretization as well as the implementation of an upwind biased discretization operator. In order to increase the efficiency of the code, a space marching technique is incorporated within regions with supersonic flow only. The

resolution of the flow field in the domain of interest is enhanced through the adaptation of the far field to the bow shock. Numerical results of a Hermes type configuration at supersonic and moderate hypersonic speeds are presented. The accurate prediction of discontinuities using the upwind formulation is demonstrated. The advantage of far field adaptation and space marching technique is verified. Comparisons with experimental data show that methods based on the equations of inviscid flow can predict flight mechanical derivatives with high accuracy. ESA

N92-14988# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Analysis and Programming Section.

FAST FINITE ELEMENT SOLVERS FOR REENTRY FLOWS

J.-P. HUOT, R.-C. MOLINA, and D. FERRER-PELLICER *In its* Aerothermodynamics for Space Vehicles p 121-127 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A methodology for the solution of the three dimensional Euler equations with chemistry effects (valid for the supersonic hypersonic range) is presented. It relies on the commercially available Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) system CAEDS for the description of the geometries and the postprocessing of the results. The mesh generation is performed with an efficient multiblock three dimensional mesh generator interfaced with CAEDS. The Euler equations are solved with a fully vectorized finite element code that uses one point integration, resulting in speeds comparable to that of finite volume solvers. ESA

N92-14989# Center for Mathematics and Computer Science, Amsterdam (Netherlands).

MULTI-DIMENSIONAL UPWIND SCHEMES, MULTIGRID AND DEFECT CORRECTION FOR ACCURATE AND EFFICIENT EULER FLOW COMPUTATIONS

B. KOREN and P. W. HEMKER *In* ESA, Aerothermodynamics for Space Vehicles p 129-134 Jul. 1991 Sponsored in part by Avions Marcel Dassault-Breguet Aviation Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Two multidimensional upwind discretizations for the steady Euler equations are presented, one with a good multigrid efficiency and the other with a good multidimensional accuracy. The two discretizations consist of a one dimensional Riemann solver with locally rotated left and right cell face states. For nonhypersonic flow computations, a standard nonlinear multigrid iteration is applied. For hypersonic flow computations, a nonlinear multigrid technique with improved robustness is presented. The robustness improvements consist of local damping of the restricted defect and a global upwind prolongation of the correction. For the steady, two dimensional Euler equations, numerical results are presented first, for some supersonic test cases with an oblique contact discontinuity and an oblique shock wave. Results for a hypersonic reentry flow around a blunt forebody with canopy are also shown. ESA

N92-14990# International Centre for Numerical Methods in Engineering, Barcelona (Spain).

FLOW AND TEMPERATURE COMPUTATIONS FOR SPACE VEHICLES USING ADAPTIVE FINITE ELEMENT TECHNIQUES

F. QUINTANA, E. ONATE, and J. MIQUEL CANET *In* ESA, Aerothermodynamics for Space Vehicles p 135-140 Jul. 1991 Sponsored in part by Instituto de Cooperacion Iberoamericana Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Computations of the laminar Navier-Stokes equations in hypersonic cases are studied using an explicit finite element method with adaptive non-structured mesh techniques to capture, accurately, the strong variations of the boundary layer and shocks. A pressure switched artificial dissipation is added to prevent oscillations in the vicinity of discontinuities. Some of the problems solved are discussed. ESA

N92-14991# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

FUNDAMENTAL EXPERIMENTAL STUDIES OF CONTROL EFFECTIVENESS AND HEATING AT HYPERSONIC MACH NUMBERS

G. SIMEONIDES and J. F. WENDT *In* ESA, Aerothermodynamics for Space Vehicles p 143-148 Jul. 1991

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Experimental results on shock wave boundary layer interactions over two and three dimensional flat plate/comparison ramp configurations at Mach numbers of 6 and 14, covering a range of Reynolds numbers to the hinge line (or apex of the swept ramps) between 300,000 and 2,600,000 are summarized. The interactions are found to act as effective trips of the boundary layer and, in some cases, transitional reattachment is observed. Configurations over which transition occurs downstream of the reattachment point may serve as computational fluid dynamics code validation test cases. Analytical and semi empirical prediction methods, originally developed for two dimensional interactions, are seen to perform satisfactorily in predicting the global features of both two and three dimensional interactions. ESA

N92-14992# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. for Theoretical Fluid Mechanics.

BASE PRESSURE MEASUREMENTS ON A CONE AT HYPERSONIC MACH NUMBERS: A CONTRIBUTION TO AEROTHERMODYNAMICS FOR SPACE VEHICLES

M. TANNER *In* ESA, Aerothermodynamics for Space Vehicles p 149-153 Jul. 1991

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Base pressure measurements performed in a 6.8 degrees cone at Mach number from $M_{\infty} = 4.99$ to 6.83 at angles of incidence from $\alpha = 0$ to 15 degrees in turbulent flow are described. The results show that the base pressure is for these Mach numbers practically independent of the angle of incidence α for these relatively small α values. The results are approximately in agreement with those achieved during free flight measurements at full scale Reynolds numbers indicating that in turbulent flow the base pressure does not depend on the Reynolds number. In a discussion concerning some theoretical methods for the prediction of base pressure it is shown that the author's theory gives results, which are in very good agreement with experiments. ESA

N92-14994# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Wind Tunnel Div.

EXPERIMENTAL STUDY OF HYPERSONIC SHOCK WAVE BOUNDARY LAYER INTERACTIONS BY MEANS OF INFRARED TECHNIQUE

A. HENCKELS, P. HERZOG, and F. MAURER *In* ESA, Aerothermodynamics for Space Vehicles p 159-164 Jul. 1991

Sponsored by DFG

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Convective surface heating due to shock wave boundary layer interaction phenomena is a critical problem for the design of thermal protection systems of future hypersonic vehicles. Tunnel experiments are presented which demonstrate how interaction phenomena can be visualized by infrared thermovision; the infrared image indicates the position of flow separation and reattachment by the temperature pattern. The capability of the used measurement technique is demonstrated and thereby the nature of shock wave boundary layer interaction is studied. The three dimensional ramp flow field, an impinging shock wave boundary of a flat plate, and an axial corner configuration under 20 degrees angle of attack were investigated. All test runs were performed in a hypersonic blow down facility at Mach numbers 6.0 and 8.7 for laminar flow condition. One interesting result achieved is the evidence that Goertler vortices are generated on a flat plate due to shock wave boundary layer interaction. ESA

N92-14995# Societe d'Etudes et de Services pour Souffleries et Installations Aerothermodynamiques, Paris (France). Lab. d'Aerothermique.

EXPERIMENTAL INVESTIGATION OF TRANSVERSE JET EFFECTS RELATED TO HYPERSONIC SPACE VEHICLES

J. ALLEGRE (Laboratoire d'Aerothermique du CNRS, Meudon (France).), M. RAFFIN (Laboratoire d'Aerothermique du CNRS, Meudon (France).), and J. P. CARESSA (Centre National de la Recherche Scientifique, Meudon-Bellevue, France) *In* ESA, Aerothermodynamics for Space Vehicles p 165-170 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Some indication on the flow interaction process which is associated with jet controls is given. A few examples of flight results on reaction control jets were presented for the Space Shuttle Orbiter. Some comparisons, with preflight predictions extrapolated from wind tunnel data obtained at lower Mach numbers and at a higher density, show some discrepancies mainly for the early stage of reentry. Experiments were carried out under rarefied hypersonic flow conditions on delta wings with trailing edge jet spoilers. Quantitative data show the jet effects in the measured aerodynamic coefficients. For the strong interaction flow regime and at various wing angles of attack, experimental results demonstrate the jet spoiler efficiency as compared with a solid spoiler efficiency. At a Mach number of 20 and under rarefied flow conditions, some preliminary experimental investigations were initiated on the Hermes model equipped with pitch reaction jet controls. It was found that at high altitudes, the flow rarefaction leads to very low efficiencies of control surfaces. For orbital flight conditions, jet control systems are than necessary to provide the required space vehicle maneuvering. Also, during the early phase of reentry, jets are used, sometimes in concert with control surfaces, to provide the vehicle aerodynamic control. ESA

N92-14996# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

INTERFERENCE HEATING NEAR FIN/BODY JUNCTIONS ON HYPERSONIC VEHICLES

Z. U. HAQ, G. T. ROBERTS, and R. A. EAST *In* ESA, Aerothermodynamics for Space Vehicles p 171-176 Jul. 1991 Sponsored by RAE Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Surface heat transfer and pressure data are presented for flat plate/fin configurations tested in an intermittent hypersonic wind tunnel at Mach 6.85. The heat transfer data were deduced from color images which show the response of thermochromic liquid crystals to the transient heating of the model of the flow. In particular, localized areas of high heat flux were apparent in the interference zones adjacent to the fin/body junction. The pressure data obtained for two fin configurations showed similar features, indicating some relationship between surface heat transfer and pressure. The influence of fin bluntness and sweep on the interference heating are described. ESA

N92-14997# Rome Univ. (Italy). Dipartimento di Meccanica e Aeronautica.

NUMERICAL SOLUTION OF DISCONTINUITY DYNAMICS: TWO DIMENSIONAL SUPERSONIC FLOWS

M. DIGIACINTO and B. FAVINI *In* ESA, Aerothermodynamics for Space Vehicles p 179-188 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A floating-shock-fitting technique for the solution of compressible inviscid flows is presented. In a previous paper the proposed technique was applied for solving unsteady one dimensional problems and is extended here to two dimensional steady supersonic flows with special attention to the treatment of geometrical boundaries. A distinguishing feature of the method is the solution procedure for the governing equations at grid points and at discontinuity points whose domain of dependence consists of both space like and time like arcs. The present formulation of mixed initial boundary value problems prompts a correct and robust

procedure for handling crossings and reflections of discontinuities, and at the same time, it greatly simplifies the design of the algorithm. Some methodological considerations are presented in order to clarify the proposed approach and to stress its validity. Numerical test cases confirm the consistency of the scheme and demonstrate its robustness. ESA

N92-14998# Institut National de Recherche d'Informatique et d'Automatique, Valbonne (France).

NUMERICAL SIMULATIONS AROUND MODELS IN HYPERSONIC WIND TUNNELS

R. ABGRALL and A. MERLO *In* ESA, Aerothermodynamics for Space Vehicles p 189-195 Jul. 1991 Prepared in cooperation with Centre National de la Recherche Scientifique, Marseilles, France Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Some very preliminary results about the problem of extrapolating the results obtained in wind tunnel to real flight conditions are related. Two experiments are proposed (the geometry is axisymmetric in both cases). The first one is the simulation of the complete nozzle with a model inside. The conditions at infinity for the models are nonuniform, in chemical and vibrational nonequilibrium. In the second experiment, the same model with an appropriate scaling parameter is considered where the conditions at infinity are obtained with the same Mach number, velocity and binary scaling parameter but with a uniform flow at chemical and vibrational equilibrium. Since this is only a preliminary study, the flows are assumed to be inviscid. The physical and chemical model used is detailed. The numerical scheme is described and the two numerical experiments performed are discussed. ESA

N92-15000# Centro Italiano Ricerche Aerospaziali, Naples.

HIGH ENTHALPY NOZZLE FLOWS

G. RUSSO, SALVATORE BORRELLI, G. LEONE, and ANTONIO SCHETTINO *In* ESA, Aerothermodynamics for Space Vehicles p 209-220 Jul. 1991 Sponsored in part by Italian Space Agency and CNES

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High enthalpy nozzle flows such as those that will be generated in the Hermes related Scirocco plasma wind tunnel are dealt with. The analysis of physical phenomenologies is made by means of a calculation procedure. The chemical and vibrational nonequilibrium effects are evidenced with respect to the specific nozzles performance and an attempt to generalize the results in terms of parametric dependencies is made. ESA

N92-15005# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

VERIFICATION AND APPLICATION OF THE NSFLEX METHOD FOR HYPERSONIC FLOW CONDITIONS

K. M. WANIE and M. A. SCHMATZ *In* ESA, Aerothermodynamics for Space Vehicles p 249-257 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The need of hypersonic reentry and cruise vehicle design to calculate viscous flow past entire configurations with wings, fins, flaps and propulsion system represents one of the major challenges for computational fluid dynamics. There is, however, still a considerable lack of experience for hypersonic flow calculations and therefore an extensive testing and verification of the numerical methods and physical modeling is essential. The verification of the multiblock Navier-Stokes code NSFLEX and its application to hypersonic flow problems is thus focused upon. The governing equations and the solution method are reviewed. The fundamental details of the multiblock incorporation, like indirect addressing and use of boundary indicators, are described. The verification is done by geometrically simple test cases. The capabilities of the method are demonstrated for realistic hypersonic configurations. ESA

N92-15006# Fluid Gravity Engineering Ltd., Witley (England).
HYPersonic AEROTHERMODYNAMIC COMPUTATIONS USING A POINT-IMPLICIT TVD METHOD

M. P. NETTERFIELD *In* ESA, Aerothermodynamics for Space Vehicles p 259-266 Jul. 1991
 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Validation cases which are typical of hypersonic reentry problems are presented for a three dimensional Navier-Stokes code with fully coupled nonequilibrium thermochemistry. The code uses a Total Variation Diminishing (TVD) formulation for the inviscid fluxes, a point implicit relaxation method of time marching, and a 2 temperature thermodynamic model, with source terms also treated in a point implicit manner. The validation cases presented include the hypersonic laminar flow over a compression corner, and high enthalpy chemically reacting flow over a circular cylinder. ESA

N92-15007# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
EFFICIENT SOLUTION OF THREE-DIMENSIONAL VISCOUS HYPersonic FLOWS

S. MENNE *In* ESA, Aerothermodynamics for Space Vehicles p 267-272 Jul. 1991
 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The Time Integration Block Marching (TIBM) method is presented in order to show a way for an efficient solution of the Navier-Stokes equations for space planes with complex geometries. The TIBM method combines the advantages of marching methods and the advantages of complete solvers. Main applications for the TIBM method are mostly supersonic flows with strong interaction regions of limited range. The complete Navier-Stokes equations are solved in these regions whereas in the other regions a marching solution is executed using a marching block consisting of a small number of cross flow planes. For validation, the TIBM method was applied to several flow problems. Some cases are presented: the flow over a two dimensional ramp with flow separation, and three dimensional flows over a yawed cone, over a two stage transport vehicle and over a blunt nosed delta wing. ESA

N92-15008# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.
VISCOUS SHOCK-LAYER EQUATIONS FOR THE CALCULATION OF REENTRY AEROTHERMODYNAMICS

ROLAND K. HOELD *In* ESA, Aerothermodynamics for Space Vehicles p 273-280 Jul. 1991
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Three dimensional Viscous Shock Layer (VSL) equations, which are derived from the Navier-Stokes equations by an order of magnitude analysis, are presented. They hold for the windward flow field of reentry vehicles at hypersonic flow conditions. Rarefaction effects are modeled at the body surface and at the bow shock by slip boundary conditions. Results of the VSL code 'VISSLA' for equilibrium real gas calculations are discussed. The influence of the slip boundary conditions, coming along with growing Knudsen numbers of the higher altitudes of reentry trajectories, is demonstrated. Comparisons with other computational fluid dynamic codes like 'NSFLEX' (Navier-Stokes calculation) show the accuracy of the VSL equations and verify the code. ESA

N92-15014# Centre National de la Recherche Scientifique, Chateauf-Malabry (France).
HYPersonic VISCOUS SHOCK LAYER IN THERMOCHEMICAL NONEQUILIBRIUM

F. THIVET, S. CANDEL, and M. Y. PERRIN *In* ESA, Aerothermodynamics for Space Vehicles p 325-333 Jul. 1991
 Sponsored by Avions Marcel Dassault; Direction des Recherches, Etudes et Techniques; and CNRS
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The basic features of a hypersonic flow are reviewed and some models for equilibrium thermodynamic properties, chemical kinetics, and transport properties of air at high temperatures are presented. To precisely describe the stagnation regions of a typical reentry vehicle, the aerodynamics of the flow is reduced to the viscous shock layer approximation. An original and fast method is presented to solve the resulting free boundary parabolic system of equations based on Newton iterations on a fixed boundary domain. A vibrational nonequilibrium model is introduced in order to determine the sensitivity of the flow to this phenomenon. The relaxation equations resulting from the kinetic theory are presented. The relaxation times involved are calculated using an extension of the SSH theory and on some experimental data. The full coupling between vibrational and chemical nonequilibrium is taken into account. The influence of these phenomenon is made evident in results obtained for different geometries. ESA

N92-15015# Centro Italiano Ricerche Aerospaziali, Naples.
INFLUENCE OF CHEMICAL MODELLING ON HYPersonic FLOW

SALVATORE BORRELLI and ANTONIO SCETTINO *In* ESA, Aerothermodynamics for Space Vehicles p 335-341 Jul. 1991
 Sponsored in part by Italian Space Agency
 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Upwind methods and the influence of chemical models are considered. An extension of an upwind methodology to the case of a nonequilibrium reacting and vibrating flow is presented and the influence of thermokinetic modelization is considered. Two classical chemical models are compared, with adding vibrational effects. The two chemical models are the Park 85 and Evans-Huber-Schexnayder. ESA

N92-15017# OHB-System G.m.b.H., Bremen (Germany).
FALKE AND COBRA TECHNOLOGY DEVELOPMENT IN AERODYNAMICS AND AEROTHERMODYNAMICS

B. STECKEMETZ (OHB-System G.m.b.H., Bremen (Germany, F.R.)), J. EWALD (OHB-System G.m.b.H., Bremen (Germany, F.R.)), W. WIENSS (OHB-System G.m.b.H., Bremen (Germany, F.R.)), A. TEGTMEIER (OHB-System G.m.b.H., Bremen (Germany, F.R.)), C. FRIEBEL (OHB-System G.m.b.H., Bremen (Germany, F.R.)), and GEORG KOPPENWALLNER (Hyperschall-Technologie-Goettingen, Germany, F.R.) *In* ESA, Aerothermodynamics for Space Vehicles p 351-358 Jul. 1991 Previously announced in IAA as A91-13281

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Wind tunnel measurements and numerical methods are well established tools to simulate the actual flow around aerodynamically supported vehicles in atmospheric flight. There are, however, limitations e.g., in the transonic and hypersonic flight regime caused by noncompliance with similarity laws, viscosity and heat conductance effects, chemical kinetics, etc. which strongly influence the accuracy of measurements and numerical calculations. Major results of two projects are reported. Both projects aim at supporting wind tunnel measurements and numeric simulations by test flights under free flight conditions. The FALKE project mainly covers the transonic and lower supersonic flight conditions, whereas COBRA is intended to cover the hypersonic speed regime. ESA

N92-15018# Aerospatiale, Les Mureaux (France). Theoretical Aerodynamic Branch.

NUMERICAL SIMULATION OF NON-EQUILIBRIUM VISCOUS FLOWS IN HYPersonic NOZZLES

V. MULARD (Aerospatiale, Les Mureaux (France).) and GILLES MOULES (Segime, Les Mureaux, France) *In* ESA, Aerothermodynamics for Space Vehicles p 359-364 Jul. 1991
 Sponsored by Avions Marcel Dassault
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Hypersonic nozzle facilities have been activated for the simulation of real gas effects over Hermes Space Plane during

reentry. For each experimentation, the complete rebuilding of the flow inside the wind tunnel is needed for further exploitations of the experimental results. An industrial numerical tool which has the ability to determine the wind tunnel flow characteristics is presented. The approach takes advantage of the specific physical behavior of the flow, namely, equilibrium flow at the entrance, nonequilibrium flow behind the throat, and frozen flow at the exit in order to calculate the flow field with the most suitable codes and at a low computing cost. Applications to Marseille and SIMOUN nozzle facilities are presented and show the feasibility of the present approach. ESA

N92-15019# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

THE DYNAMIC RESPONSE OF SEPARATED HYPERSONIC FLOWS

A. J. D. SMITH and R. A. EAST /in ESA, Aerothermodynamics for Space Vehicles p 365-370 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The dynamic response of a separated hypersonic flow to a rapidly actuated trailing edge flap was investigated. Experimental measurements showed a lag in the rate of separation growth, which was attributed, principally, to the requirement for mass entrainment. Measurements of heat transfer for the evolving dynamic separation have an increased level in the reattachment region at high flap angles, in excess of that for equivalent steady separated flows. Simple analytic models were developed which support the proposed mechanisms of unsteady separated flow adjustment. ESA

N92-15023# Technische Univ., Munich (Germany). Lehrstuhl fuer Fluidmechanik.

TESTING HIGH ORDER SHOCK-CAPTURING SCHEMES IN 2D SUPER- AND HYPERSONIC FLOWS

T. HAUSER, R. HANNAPPEL, and R. FRIEDRICH /in ESA, Aerothermodynamics for Space Vehicles p 393-399 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A comparison of the MUSCL and implementations of the different Essentially Non-Oscillatory (ENO) schemes for the numerical solution of the time dependent Euler equations is presented. One and two dimensional examples are chosen with features pertinent to the shock turbulence interaction. The suitability of the ENO schemes for blunt body calculations is also shown. The resolution of the different numerical schemes is compared quantitatively by calculating the L_1 norms for the error. The results show the superiority of the ENO schemes over the MUSCL approach in solving problems which contain both shocks and fine structure in smooth regions. On the other hand the MUSCL scheme is faster than the ENO schemes. ESA

N92-15025# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Div. de Thermophysique.

HYPERSONIC INVISCID FLOW FIELD SIMULATIONS AROUND REENTRY VEHICLES WITH FLAP DEFLECTION

J. L. DACOSTA /in ESA, Aerothermodynamics for Space Vehicles p 407-412 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The study of the reentry phase of spacecrafts like the European Hermes Spaceplane needs the determination of complex three dimensional flows. In order to simulate such hypersonic flows, a multidomain Euler code, named FLU3M, was developed. This code is based upon an explicit/implicit finite volume method of MUSCL type using structured grids. Calculations can be performed either by a time dependent method for subsonic region of the flow, or by space marching procedure for supersonic regions. The hypersonic flowfield around Hermes configurations is investigated. Computations are performed at a freestream Mach number of 10 and 25, for 30 degrees angle of attack and without any sideslip. The simulation is realized under perfect gas or equilibrium air assumption. The aims of the paper are mainly to show the feasibility

of three dimensional computations around complex geometries including flap deflection and real gas effects, and to evaluate accurately the flap efficiency. ESA

N92-15031# Hyperschall-Technologie-Goettingen (Germany). BEHAVIOUR AND MODELLING OF THE AEROTHERMODYNAMICS OF BALLISTIC ENTRY VEHICLES IN THE HIGH ALTITUDE FLOW REGIMES

GEORG KOPPENWALLNER and DIETER JOHANNSMIEIER /in ESA, Aerothermodynamics for Space Vehicles p 461-467 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Special aerodynamic methods, which allow fast aerodynamic performance prediction, are needed for initial design and trajectory calculations. During reentry the flow behavior changes from free molecular through the rarefied regimes to continuum hypersonic. In addition the Mach number decreases from 25 down to low hypersonic. A semiempirical method was adopted to develop formulae for the aerodynamic data prediction. The approach applies the axisymmetric bodies and allows the prediction of lift and drag during the hypersonic entry phase. The bridging between free molecular and continuum flow is based on experiments and on Newtonian and free molecular theory. ESA

N92-15032# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. for Experimental Fluid Mechanics.

APPLICABILITY OF BRIDGING METHODS TO HYPERSONIC RAREFIED FLOW AERODYNAMICS OF REENTRY VEHICLES

ROLF-D. BOETTCHER /in ESA, Aerothermodynamics for Space Vehicles p 469-476 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Local bridging methods for transition flow aerodynamics are applied to several shapes including Hermes. Results are compared to wind tunnel data and analyzed with respect to method applicability limits. The conclusion drawn states the necessity of tailoring the methods to the specific configuration under investigation, in close cooperation with wind tunnel experiments. ESA

N92-15035# Aerospatiale, Les Mureaux (France). Theoretical Aerodynamic Branch.

TRANSITIONAL FLOWS AROUND RE-ENTRY BODIES

JEAN-FRANCOIS PALLEGIOIX /in ESA, Aerothermodynamics for Space Vehicles p 491-496 Jul. 1991 Sponsored by Avions Marcel Dassault

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Flow calculations as solutions of the Boltzmann equation, using the Direct Simulation Monte Carlo (DSMC) method, are presented. The code used was developed in order to calculate flows around complex three dimensional bodies like Hermes. The algorithms for moving molecules and searching for their impact on the wall are based on simple criteria, furthermore the code is fully vectorized. Four calculations on Hermes shape and two other calculations are presented and compared with wind tunnel data, in terms of aerodynamic coefficients or heat transfer. For each calculation, the number of cells and molecules is given, together with storage and Central Processing Unit (CPU) requirements. The discrepancies between calculations and measurements are checked with a simulation of the nonuniformity in the wind tunnel flow. ESA

N92-15040# Aerospatiale, Les Mureaux (France). Theoretical Aerodynamic Branch.

COMPUTATION OF AERODYNAMIC COEFFICIENTS ON HERMES-ARIANE5 CONFIGURATION

CHRISTOPHE GRASSIN /in ESA, Aerothermodynamics for Space Vehicles p 537-542 Jul. 1991 Sponsored by CNES

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A numerical prediction of aerothermodynamic coefficients, for the Hermes-Ariane configuration, based on structured-nonstructured Euler solvers is presented. The application is performed for Mach number 1.47 and an angle of attack of 3 degrees. Results are found to compare well with experimental data. ESA

N92-15041# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

GRID IMPACT ON 3D HYPERSONIC FLOWS

J. HAEUSER, H. WONG, J. GRAWE, and W. BERRY *In its* Aerothermodynamics for Space Vehicles p 543-548 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Four, three dimensional (3D), Euler solutions for the Hermes configuration are presented and the impact of the distance of the first layer of points, from the surface, on the pitching moments and lift coefficients is investigated. Results are given. It was shown that for Euler solutions of three dimensional vehicles the computational grid has a strong impact on some of the aerodynamic parameters, which by far exceed the design margins. Therefore, three dimensional solutions have to be checked for grid dependence. This situation is aggravated when a Navier-Stokes solver is used to calculate heat fluxes. Here a special feature of the grid can be used to interactively convert an Euler grid into a Navier-Stokes grid by removing or adding grid lines using a specified distribution to capture the boundary layer. A set of 100,000 points can be deleted/added in a few minutes. ESA

N92-15042# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

AEROTHERMODYNAMIC CHALLENGES OF THE SAENGER SPACE-TRANSPORTATION SYSTEM

E. H. HIRSCHHEL *In* ESA, Aerothermodynamics for Space Vehicles p 549-558 Jul. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The two stage to orbit Saenger space transportation system is considered. The technology development concentrates first on the needs of the lower stage. Its requirements for aerothermodynamics and propulsion integration are sketched. The aerothermodynamic design challenge is discussed. The design tools and the design methodology are reviewed. The validation of both the computational and the experimental methods, as well as the test of vehicle components, like the inlet and control surfaces, make the experimental vehicle Hytex mandatory. Contents and workplan of the technology program 'Aerothermodynamics and propulsion integration' are laid out. Selected results from the current work are presented. ESA

N92-15970 ESDU International Ltd., London (England).

A METHOD OF ESTIMATING A FLOW BREAKDOWN BOUNDARY FOR AEROFOILS AND SWEEPED WINGS IN TRANSONIC FLOWS

Oct. 1991 37 p

(ISSN 0141-397X)

(ESDU-91021; ISBN-0-85679-783-9) Avail: ESDU

A method is given of estimating the boundary beyond which as either lift coefficient or Mach number is increased, the turbulent boundary layer on the upper surface separates from the foot of the shock to the trailing edge. Features of experimental pressure distribution are found to correlate with the onset of flow breakdown. In both methods (also ESDU 81020), it was found that those same features of a pressure distribution calculated by techniques that do not model separation could be used similarly. In this case, the bubble length is found to be a function of local Mach number and momentum thickness at the shock location, while the point of reattachment was found to correlate with features of the adverse rear gradient. Using those features, a step-by-step procedure for predicting the flow breakdown boundary is presented and was checked against experimental data for airfoils, and wings with quasi-two-dimensional flow. Two comprehensive worked examples

show the use of the method. It is believed to predict the boundary with a rms error of 0.04 in lift coefficient when the Mach number is increasing or within 0.01 in Mach number when the lift coefficient is increasing. ESDU

N92-15971 ESDU International Ltd., London (England).

CONTRIBUTION OF FIN AND TAILPLANE TO SIDEFORCE AND YAWING MOMENT DERIVATIVES DUE TO SIDESLIP AT SUPERSONIC SPEEDS AT LOW ANGLES OF ATTACK

Nov. 1991 36 p

(ISSN 0141-397X)

(ESDU-91031; ISBN-0-85679-794-4) Avail: ESDU

ESDU 91031 presents a method for estimating the derivatives based on apparent mass calculations that allow for interference effects of body, wing, and tailplane on the fin. The method is modified as a result of comparisons with experimental data drawn from the literature for mid and low wing or tailplane position for which the theory tends to overestimate the sideforce. The method factors the lift-curve slope of an isolated surface for the interference effects, and values for that may be found from ESDU 70012. To establish the yawing moment, the sideforce is assumed to act at the aerodynamic center, which is also predicted using ESDU 70012. The method applies to a single fin in the plane of symmetry and body-mounted tailplane; however, recommendations are made on how it may be extended to treat fin-mounted tailplanes which in fact only make small contributions to these derivatives. It applies for angles of attack less than five degrees and angles of sideslip less than four degrees. The behavior of the derivatives up to angles of attack of 20 degrees is illustrated in a particular case and compared with predictions from an extended theory. Sketches show the comparison of predicted with experimental results drawn from the literature; agreement is found to be within 15 percent, which is in any case the anticipated tolerance on values of lift-curve slope from ESDU 70012. ESDU

N92-15973 ESDU International Ltd., London (England).

EXCRESCENCE DRAG MAGNIFICATION FACTORS AT THE DRAG-RISE CONDITION FOR AEROFOILS WITH A SPECIFIED FORM OF UPPER-SURFACE PRESSURE DISTRIBUTION

Nov. 1991 60 p

(ISSN 0141-397X)

(ESDU-91029; ISBN-0-85679-791-X) Avail: ESDU

Data are given for the chordwise variation of the magnification factor on the upper and lower surfaces of a family of airfoils designed to combine a high drag-rise Mach number with a high lift coefficient for given thickness/chord ratio. (The geometry and pressure distribution at the design condition are described in ESDU 71020 and profile drag data are given in ESDU 67011.) The data are typical of airfoils designed for that purpose and were obtained using the program of ESDU 91028. They are presented in tables together with normalized values of local flow properties and boundary layer momentum thickness on both airfoil surfaces, and also graphically. The influence of systematic variations of thickness/chord ratio, design Mach number, and extent of upper surface roof top are discussed. A worked example illustrates the use of both the tabulated and graphical data in conjunction with excrescence drag data for grooves in uniform flow from ESDU 75028. ESDU

N92-17311# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

COMPARISON OF TWO SOLUTION METHODS FOR THE NUMERICAL CALCULATION OF HYPERSONIC FLOWS Thesis - Univ. der Bundeswehr Muenchen [VERGLEICH ZWEIER LOESUNGSVERFAHREN ZUR NUMERISCHEN BERECHNUNG VON HYPERSCHALLSTROEMUNGEN]

CHRISTOPH MUELLER 31 Dec. 1990 162 p In GERMAN

(MBB-FE211-S-PUB-446; ETN-92-90617) Copyright Avail:

CASI HC A08/MF A02

Two methods for the numerical calculation of hypersonic flows were compared. The first solves the complete Navier-Stokes equations, and the second solves the viscous shock layer equations. The algorithms of both methods are explained. The

02 AERODYNAMICS

Navier-Stokes equations were transformed for the vector notation time, application domains, and accuracy of the algorithms of both methods were compared with each other, as well as with a combined Euler boundary layer method. Good agreement between the methods is found. ESA

N92-17314# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).

A SHORT OR A LONG CYLINDER: WHAT DIFFERENCE DOES IT MAKE TO THE KARMAN VORTEX STREET?

HOLGER EISENLOHR 1990 92 p In GERMAN; ENGLISH summary (ISSN 0374-1257)

(MPIS-98/1990; ETN-92-90621) Avail: CASI HC A05/MF A01

The difference between the behavior of the Karman vortex sheet for a short and a long circular cylinder placed perpendicular to the flow, was investigated in a wind tunnel. The complicated interaction between the vortex filaments results in a distortion of the wake profile and a change of the base pressure near the cylinder ends. This causes the vortex shedding frequency near the cylinder ends to diminish, and also leads to slanted shedding. Thus, regions of different shedding frequency appear and vortex splitting takes place. This can cause discontinuities in the smooth function normally observed. The discontinuities and slanted shedding disappear if the disturbed end regions are decoupled from the rest of the cylinder by using 'end cylinders'. ESA

N92-17315# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).

INVESTIGATION ON THE CONTROL OF A KARMAN VORTEX STREET

ERIKA ROESCH 1990 59 p In GERMAN; ENGLISH summary (ISSN 0374-1257)

(MPIS-99/1990; ETN-92-90622) Avail: CASI HC A04/MF A01

A Karman vortex street was controlled without feedback, according to the theory of Huebler, using a differential equation reconstructed by Ohle for the description of the flow in the wake of a circular cylinder. The validity of the theory was checked for its applicability to complex systems. The effectiveness of the specially calculated driving force was compared to an appropriate linear driving force. It is shown that a Van der Pol oscillator is no adequate model to control the vortex street, because the decisive terms of higher degree are absent. These terms are present in the differential equation reconstructed by Ohle, so that the prediction of the response of the vortex street to perturbations is possible. ESA

N92-18231# Manchester Univ. (England). Aeronautical Engineering Group.

MARCHING WITH THE PARABOLIZED NAVIER-STOKES EQUATIONS. PROBLEM 1: NUMERICAL STUDY OF HYPERSONIC VISCOUS CONE FLOW

S. SHAHPAR, I. M. HALL, and D. I. A. POLL 1990 22 p (AERO-REPT-9007; ETN-92-90924) Avail: CASI HC A03/MF A01

A general noniterative, three dimensional parabolized Navier-Stokes code was developed to predict the steady viscous flow field about objects traveling at high supersonic/hypersonic speeds. The equations are solved with an implicit approximate factorization finite difference scheme which is second order accurate in the cross flow directions. An implicit boundary condition was used which was compatible with the finite difference schemes used on the interior mesh. The grid used is generated by a simple algebraic method. Vigneron's technique was used to suppress the departure solution. The code is applied to laminar hypersonic flow, $M(\text{sub infinity}) = 9.16$, $Re(\text{sub infinity}) = 5.5 \text{ times } 10$ to the 7th power/m, past a slender cone to 7 degree half angle and the computed shock shape, surface pressure, skin friction, and Stanton number are presented for comparison with experimental results. ESA

N92-18232# Manchester Univ. (England). Aeronautical Engineering Group.

MARCHING WITH THE PARABOLIZED NAVIER-STOKES EQUATIONS. PROBLEM 2: HYPERSONIC VISCOUS FLOW OVER A FLAT PLATE

S. SHAHPAR, I. M. HALL, and D. I. A. POLL 1990 16 p (AERO-REPT-9008; ETN-92-90925) Avail: CASI HC A03/MF A01

The noniterative implicit space marching Parabolized Navier-Stokes (PNS) code described previously was used to compute the steady hypersonic ($M(\text{sub infinity}) = 5$ and 10), viscous ($Re(\text{sub infinity})/m = 0.000006$ and $Re(\text{sub infinity})/m = 0.000003$) flow fields over a flat plate aligned with the freestream. Flow maps for density, pressure, and Mach number as well as surface pressure, skin friction, and Stanton number are presented for comparison with experimental results. ESA

N92-18318# Manchester Univ. (England). Aeronautical Engineering Group.

TOWARDS THE COMPUTATION OF TURBULENT HYPERSONIC FLOWS

B. E. LAUNDER (Manchester Coll. of Science and Technology, England) and D. I. A. POLL Aug. 1991 110 p (AERO-REPT-9106; ETN-92-90937) Avail: CASI HC A06/MF A02

The status of engineering turbulence modeling in relation to the problem of predicting hypersonic turbulent flows is considered. To provide a perspective for making such an assessment, the experimental data base and the associated experimental uncertainties are reviewed. Various levels of turbulence model are considered proceeding from the simplest (algebraic eddy viscosity models) to the most elaborate (multiple scale models based on transport equations for the turbulent stresses). No attempt is made to cover the problem of transition from laminar to turbulent flow in a quiescent free stream. Since, however, incompletely turbulent boundary layers are the general rule at hypersonic speed, particular attention is given to the capabilities of different levels of turbulence model in predicting flows with abnormally thick viscous sublayers. ESA

N92-19296# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

MODELLING OF CHEMICAL AND PHYSICAL EFFECTS WITH RESPECT TO FLOWS AROUND REENTRY BODIES

C. MUNDT and E. H. HIRSCHL 30 Sep. 1991 15 p Presented at the 3rd Aerospace Symposium, Brunswick, Fed. Republic of Germany, 26-28 Aug. 1991

(MBB-FE-211/S/PUB/0465/A; ETN-92-91000) Copyright Avail: CASI HC A03/MF A01

A method which solves the Euler and boundary layer equations for hypersonic, chemical nonequilibrium flows is presented. The high temperature air is modeled by a mixture of five species, each considered to behave as a thermally perfect gas. The transport properties are modeled using the Lennard-Jones potential. Applications are presented for the Hermes configuration. A theoretical comparison, with cases including typical wind tunnel influences such as free stream dissociation, for example, shows the versatility of the method. ESA

N92-19679# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics.

EXPERIMENTAL STUDIES OF VORTEX FLAPS AND VORTEX PLATES. PART 1: 0.53 M SPAN 60 DEG DELTA WING

K. RINOIE (National Aerospace Lab., Tokyo, Japan) and J. L. STOLLERY Aug. 1991 44 p

(CRANFIELD-AERO-9113-PT-1; ISBN-1-871564-33-6; ETN-92-91052) Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC 8 sterling pounds

Low speed tunnel tests were made to investigate the flow around a leading edge vortex flap at the maximum lift/drag conditions. Tests were also made to measure the performance of the inverted vortex flap and the vortex plate. The force measurements and flow visualization tests were conducted in a

60 degree delta wing model. Results indicate that the lift to drag ratio is a maximum for any given flap deflection angle when the flow comes smoothly onto the deflected vortex flap without forming a large leading edge separation vortex in the flap surface. The benefit of the vortex plate is seen in the drag results which are smaller than those for the datum wing. This benefit is due to some leading edge suction acting on the forward facing region between the delta wing and the vortex plate. ESA

N92-19682# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de l'Aérodynamique.
DRAG PREDICTION USING COMPUTATION METHODS Final Summary Report [PREVISION DE LA TRAINEE A PARTIR DES METHODES DE CALCUL. RAPPORT DE SYNTHESE FINAL]

J. J. THIBERT, J. L. GODARD, and F. MONTIGNY-RANNOU Feb. 1989 61 p In FRENCH
 (Contract DRET-88-34-001)
 (ONERA-RSF-82/1685-AY-154-4; ETN-92-91080) Avail: CASI HC A04/MF A01

Different two and three dimensional computation methods for the prediction of drag were studied. The integration of pressure was concluded to not allow a correct estimation of the $C_{(sub\ x)}$ pressure term which is too sensitive to numerous parameters (equations, mesh, convergence, numerical viscosity, etc.). This term can perhaps be evaluated using motion evaluation which gives access to the $C_{(sub\ x)}$ shock and $C_{(sub\ x)}$ induced terms. The accuracy thus obtained depends on the evaluation process used and on the numerical method (type of equations, numerical scheme, artificial viscosity, etc.). The best evaluations of viscous effect drag are obtained using wake calculations. The evaluations made show that it is possible to attain accuracy of some 'percent' in the absence of spread detachment. This accuracy level is adapted by adapting the $C_{(sub\ x)}$ estimation method to the computation method used. Detail and precise tests in two and three dimensions are necessary to further improve the prediction methods. ESA

N92-19925# Centre d'Etudes Aérodynamiques et Thermiques, Poitiers (France). Lab. d'Etudes Aérodynamiques.
HYPERSONIC WAKES Final Report [SILLAGES HYPERSONIQUES. RAPPORT FINAL]

M. C. GUEGAN, C. TENAUD, and T. ALZIARY Jul. 1991 72 p In FRENCH
 (Contract DRET-89-34-080-00-470-75-01)
 (ETN-92-91082) Avail: CASI HC A04/MF A01

Experimental studies on transition over a cone in hypersonic regime, and transition in wakes and near wakes, are presented. The experimental wind tunnel setup is described. The code developed for the bottom flow in laminar hypersonic regime is presented. The introduction of turbulence modeling is described. ESA

N92-20468# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

MATGRID: A PROGRAM FOR GENERATION OF C-H AND C-O TOPOLOGY GRIDS AROUND WING/BODY CONFIGURATIONS. MATHEMATICAL DEFINITION DOCUMENT

SVEN G. HEDMAN and LARS G. TYSELL Oct. 1991 34 p Sponsored by National Swedish Board for Technical Development (FFA-TN-1990-19; ETN-92-91058) Avail: CASI HC A03/MF A01

MATGRID is a computer program for generation of C-H or C-O topology grids for the discretization of flow fields around configurations consisting of a wing alone or a wing and a fuselage. It was developed within the cooperative program MATGRID/MATRICES primarily for use together with the full potential flow solver MATRICES (Multi Component Aircraft Transonic Inviscid Computation System). The mathematical principles used in the construction of the grid generation procedure are described. ESA

N92-20473# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

INVISCID DRAG PREDICTION FOR TRANSONIC TRANSPORT WINGS USING A FULL-POTENTIAL METHOD

J. VANDERVOOREN and A. J. VANDERWEES 8 Nov. 1989 23 p Presented at the 28th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, 8-11 Jan. 1990
 (Contract NIVR-01501-N)
 (NLR-TP-89365-U; ETN-92-90961; AD-B158639L) Avail: CASI HC A03/MF A01

A theory of drag analysis in full potential flow, based on generalization and extension of Garabedian's and McFadden's idea of determining wave drag by volume integration of the artificial viscosity, is summarized. An illustrative example demonstrates that the theory predicts the change in wave drag on a wing between a fully conservative and a nonconservative solution qualitatively correct and quantitatively realistic. A series of mesh refinement experiments on nested grids was carried out for a DFVLR F4 wing in transonic flow, using CH as well as CO topology grids, with the purpose of providing insight into the accuracy of inviscid drag prediction for transonic transport wings. The MATRICES code used in the experiments is first order accurate in the mesh size throughout supersonic flow regions. In particular in CO topology grids, where the improved wing tip resolution generally resolves the tip vortex much better than on CH topology grids, the velocities in the core of this requires a local modification of the flow model. CO topology grids are concluded to be better suited for drag analysis than are CH topology grids. Another conclusion is that the accuracy of each individual drag component can be improved by extrapolating to the limit of vanishing mesh size. In order to avoid excessively fine grids in an engineering environment, the need for artificial viscosity terms that are second order small in the mesh size in supersonic flow regions, except for the immediate vicinity of the shock waves, is stressed. Extrapolation procedures are believed then however to remain necessary for accurate drag prediction. ESA

N92-20498# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

NUMERICAL SIMULATION OF VORTICAL FLOW OVER A DELTA WING AT SUBSONIC AND TRANSONIC SPEEDS

H. W. M. HOEIJMAKERS, J. M. J. W. JACOBS, and J. I. VANDENBERG 1 May 1990 19 p Presented at the 17th ICAS Congress, 9-14 Sep. 1990. Stockholm, Sweden Sponsored by Netherlands Agency for Aerospace Programs and Ministry of Defence
 (NLR-TP-90029-U; ETN-92-90962; AD-B158645L) Avail: CASI HC A03/MF A01

The flow about a 65 degree sharp edged cropped delta wing is simulated by solving the Euler equations. Solutions are obtained for the wing at a subsonic, free stream Mach number and high angle of attack, where a strong vortex forms above the wing upper surface as well as for the wing at a transonic free stream Mach number and high incidence resulting in shocks and strong vortices. For the latter case the development of the flow field with the incidence is studied, while for both cases the formation of the wake downstream of the trailing edge is investigated. The influence of the mesh resolution on the details of the solution is analyzed utilizing a mesh of 0-0 topology, which on its finest level has more than one million grid points in the half space around the starboard side of the delta wing. ESA

N92-20797# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel Working Group 13.

AIR INTAKES FOR HIGH SPEED VEHICLES

Sep. 1991 263 p
 (AGARD-AR-270; ISBN-92-835-0637-5; AD-A248270) Copyright Avail: CASI HC A12/MF A03

The results of a study by Working Group 13 of the AGARD Fluid Dynamics Panel are presented. The scope of the investigation included intake aerodynamics, intake/engine compatibility, and intake/airframe integration for both aircraft and missiles. The

02 AERODYNAMICS

present capability of Computational Fluid Dynamics (CFD) methods was assessed through a comparative analysis of both CFD predictions and experimental data. This analysis was conducted for eight different flow field test cases designed to produce critical features of air-intake flow fields. Flow field results and comparisons are presented both in the report and in a microfiche appendix. Air-inlet wind tunnel testing techniques and limitations were also investigated and reported. Results from measurements of inlet performance from three European wind tunnels using a common axisymmetric pitot intake are also presented. The participants in Working Group 13 represented Belgium, France, Germany, Italy, the United Kingdom, and the United States. Author

N92-21703# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

THREE-DIMENSIONAL SIMULATIONS OF HYPERSONIC FLOWS

MICHAEL PFITZNER, W. SCHROEDER, S. MENNE, and CLAUS WEILAND 4 Sep. 1991 15 p Presented at International Conference on Hypersonic Aerodynamics, Manchester, England, 4-6 Sep. 1989 Previously announced in IAA as A91-21184 (MBB-UK-0155-89-PUB; ETN-92-90998) Avail: CASI HC A03/MF A01

Flow codes for the simulation of three dimensional hypersonic flows are presented. The equilibrium real gas flow about a reentry configuration and about a two stage reusable launch vehicle is simulated by a code based on the quasi conservative form of the Euler equations in conjunction with a bow shock fitting algorithm and a Runge-Kutta time stepping scheme. Imbedded shocks are captured. Flows about more complicated geometries containing very strong shocks are simulated using a code based on a symmetric TVD discretization and explicit and implicit time integration. ESA

N92-21784# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.

TWO-DIMENSIONAL TRANSONIC FLOW CALCULATION BY INTERACTION OF EULER AND BOUNDARY LAYER EQUATIONS

Z. ZIQIANG and T. SIIKONEN 26 Oct. 1990 44 p (PB92-136449; SER-B-90-B27; ISBN-951-22-0389-8) Avail: CASI HC A03/MF A01

A viscous/inviscid interaction calculation, based on the Euler and inverse boundary layer equations, is described for computing transonic flows over airfoils. The Euler method is modified to include a prescribed surface transpiration flux distribution obtained from the inverse boundary layer method, which allows calculation of flows with separation. Solutions are presented for airfoils with relatively strong shocks and with separation. The results show good agreement with experimental data. GRA

N92-22179# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CONTRIBUTIONS OF MBB-FE211 TO THE 2ND ANTIBES WORKSHOP ON HYPERSONIC FLOWS

FRANCOIS MONNOYER 30 Apr. 1991 99 p Presented at Workshop on Hypersonic Flows for Reentry Problems, Part 2, Antibes, France, 15-19 Apr. 1991 (MBB-FE211-S-PUB-449; ETN-92-90619) Copyright Avail: CASI HC A05/MF A02

Calculations performed with the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for the Navier-Stokes equations for a wide range of Mach numbers) on the following are illustrated: flow over a two dimensional ramp; double ellipsoid; and a delta wing. Euler boundary layer calculations for ellipsoid and blunt nose delta wing are illustrated. ESA

N92-22180# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

PROBLEM 3: FLOW OVER A 2-D RAMP NAVIER-STOKES CALCULATIONS

J. FISCHER and M. SCHMATZ In its Contributions of MBB-FE211

to the 2nd Antibes Workshop on Hypersonic Flows p 1-17 30 Apr. 1991

Copyright Avail: CASI HC A03/MF A02

Calculations of flow over a two dimensional ramp using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for a wide range of Mach numbers) are illustrated. The inviscid flow fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flow extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. Viscous fluxes are constructed with central differencing at the cell faces. The unfactored time dependent implicit equations converge in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22181# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CASES 6.1 AND 6.8 DOUBLE ELLIPSOID: NAVIER-STOKES CALCULATION

M. SCHMATZ and R. HOELD In its Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows p 18-37 30 Apr. 1991

Copyright Avail: CASI HC A03/MF A02

Calculations of flow over a double ellipsoid using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for a wide range of Mach number) are illustrated. The inviscid fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flux extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of the flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. The viscous fluxes are constructed with central differencing at the cell faces. The unfactored time-dependent implicit equations are converged in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22182# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CASE 7.4 DELTA WING: NAVIER-STOKES CALCULATION

R. HOELD and M. SCHMATZ In its Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows p 38-57 30 Apr. 1991

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Calculations of flow over a delta wing using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for a wide range of Mach numbers) are illustrated. The inviscid fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flux extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of the flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. The viscous fluxes are constructed with central differencing at the cell faces. The unfactored time-dependent implicit equations are converged in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22183# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CASE 6.1 AND 6.8 ELLIPSOID: EULER-BOUNDARY LAYER CALCULATION

FRANCOIS MONNOYER In its Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows p 58-77 30 Apr. 1991

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Flow around an ellipsoid is presented. The model applied is a coupled Euler boundary layer model. The Euler equations are solved using Pfitzner's EULSPLIT code. In the inner viscous region, the second order boundary layer equations are solved using Monnoyer's SOBOL code. A defect formulation of the boundary layer equations is used to take second order effects typical of hypersonic flows, such as entropy swallowing and external vorticity, into account. No displacement effect is included in the results presented. ESA

N92-22193# Cambridge Univ. (England). Dept. of Engineering.
A THEORETICAL INVESTIGATION OF THE INDUCED DRAG OF WING OF FINITE ASPECT RATIO
 F. LAM Dec. 1991 50 p Sponsored in part by Croucher Foundation and Trustees
 (ISSN 0309-7293)
 (CUED/A-AERO/TR-17(1991)) Avail: CASI HC A03/MF A01

The Lanchester-Prandtl lifting-line theory for finite aspect ratio wings has been revised with an entirely new model of trailing vortex wake which takes into account the mean effect of the roll-up of the trailing vortex sheet. Comparison with the original planar model shows that the downwash induced by the proposed wake can be usefully low for given loadings over a range of downstream distance, within which a trailing vortex sheet has reached a state of concentrated vortices. The induced drag is consequently lowered due to the favorable upwash generated by the roll-up vortices. There exists an optimum downstream location for the completion of the roll-up process which gives rise to a minimum drag in each loading case examined in this paper. This minimum is even lower than the least drag predicted by the classical lifting-line theory. Author

N92-22233# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.
MODERNIZED MMB PANEL CODE: USER'S GUIDE INCLUDING BACKGROUND THEORY
 E. SALMINEN 28 Aug. 1991 49 p
 (PB92-136431; SER-B-91-B33; ISBN-951-22-0763-X) Avail: CASI HC A03/MF A01

A modernized version of the MMB low-order panel method program written originally at the beginning of the 1970's is described. The new features of the combined version are the capability to read list-directed input, the capability to handle transpiration velocities through panel surfaces, and the capability to handle comment lines in an input file. The new version is also easier to use and easier to port to different types of machines than the original one. In addition to the combining process, the program was also linked to a specialized flow visualization program in order to expedite the pre- and post-processing. The link makes it possible to check the model and analyze the results using high-performance graphics workstations. Some DISPLA-based plotting routines were also written for inspecting the model and representing the results on graphical terminals. A user's guide and a background theory are included. GRA

N92-23168# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
HYPERSONIC LAMINAR FLOW COMPUTATIONS OVER A BLUNT LEADING EDGED DELTA WING AT THREE DIFFERENT CHORD REYNOLDS NUMBERS
 SHIVAKUMAR SRINIVASAN, PETER ELIASSON, and ARTHUR RIZZI Oct. 1991 17 p
 (Contract VUB-8356/89/NL/FG(SG))
 (FFA-TN-1991-40; ETN-92-91194) Avail: CASI HC A03/MF A01

The hypersonic flow past a blunt leading edged and a blunt nosed delta wing was simulated numerically by solving the three dimensional Navier-Stokes equation. The laminar flow simulations were performed for three different chord Reynolds numbers. The Navier-Stokes equations were solved using the explicit finite volume four stage Runge-Kutta scheme. The intent is to reach a reasonable understanding of the separation characteristics of the flow in the leeside. It was observed that in the case of blunt edged delta wings at high angles of attack, the hypersonic flow is dominated by a shear layer that separates just past the blunt leading edge forming a more distributed vortical region over the wing, rather than a concentrated vortex structure as observed at lower speeds. As the Reynolds number increases, the separation characteristic on the lee side of the wing changes from a primary separation near the wing mid semi span to a primary separation close to the leading edge and a secondary separation near the wing mid semi span. The shape of the wing apex determines the location of the chords plane where the separation begins. The solutions were not compared with experimental data due to the nonavailability of

the data at the time of writing. Sensitivity of the flow field to mesh refinement was investigated for the low Reynolds number case and it was found that the characteristics of the flow field remains the same even after mesh refinement. ESA

N92-24394# Technische Hochschule, Aachen (Germany). Lehr- und Forschungsgebiet fuer Mechanik.
HYPERSONIC CONFIGURATIONS IN SLOW SPEED FLIGHT [HYPERSONISCHE KONFIGURATIONEN IM LANGSAMFLUG]
 C.-A. MUELLER /n Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 111-112 Dec. 1990 In GERMAN
 Avail: CASI HC A01/MF A02

Theoretical methods for inviscid and compressible, stationary subsonic flows about hypersonic flight configurations are developed with a view to the design of such configurations. These are reliable numerical methods for the boundary layer calculation, for the prediction of flow separation, for the simulation of the produced free vortices, as well as for the prediction of the global aerodynamic behavior of the configuration. ESA

N92-24395# Technische Hochschule, Aachen (Germany). Lehr- und Forschungsgebiet fuer Mechanik.
SUPERSONIC FLOW IN COMPRESSION STAGES AND INLETS [UEBERSCHALLSTROEMUNGEN IN VERDICHTERSTUFEN UND EINLAEUFEN]
 I. GROTOWSKY /n Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 113-114 Dec. 1990 In GERMAN
 Avail: CASI HC A01/MF A02

Characteristic oriented calculation methods are developed for supersonic flows in compressors and inlet diffusers. The aim is to obtain design hints for the integration of inlets in hypersonic configurations and for channel geometries with possibly low loss delay of the supersonic flow in compressors and inlets using oblique shock systems. The high thermal loading in the corners of the inlet channels has to be analyzed and improved. A numerical bicharacteristics method for compressor with axial supersonic flow gives good approximate results, although for the calculation of multishock systems Godunov type procedures have to be used. ESA

N92-24645# Centre National d'Etudes Spatiales, Toulouse (France). Div. Ballons.
THE CONCEPT OF A LONG DURATION STRATOSPHERIC BALLOON [CONCEPT D'UN BALLON STRATOSPHERIQUE OUVERT DE LONGUE DUREE]
 CHRISTIAN TOCKERT /n ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 321-325 Nov. 1991 In FRENCH
 Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The design of a new type of stratospheric balloon which can maintain a stable flight level at night without resorting to dropping the ballast is considered. The approach taken is to cover the upper part of the balloon with an insulating cape, the equivalent to 3 pct. of the total diurnal surface. During the night descent, the volume decreases and the cape tends to cover a greater percentage of the gas moistened surface until 50 pct. is reached. Even under several radiative conditions, this configuration improved the thermal balance of the balloon and stabilized it in the low stratosphere. As soon as the Sun comes out, the balloon regains its diurnal flight level. In this way numerous day night cycles are repeated. A three week flight does not seem impossible. ESA

N92-25959*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
FINITE ELEMENT METHODS FOR INTEGRATED AERODYNAMIC HEATING ANALYSIS Report, 1 Oct. 1990 - 30 Sep. 1991
 K. MORGAN and J. PERAIRE 1991 22 p

02 AERODYNAMICS

(Contract NAGW-1809)

(NASA-CR-190353; NAS 1.26:190353) Avail: CASI HC A03/MF A01

This report gives a description of the work which has been undertaken during the second year of a three year research program. The objectives of the program are to produce finite element based procedures for the solution of the large scale practical problems which are of interest to the Aerothermal Loads Branch (ALB) at NASA Langley Research Establishment. The problems of interest range from Euler simulations of full three dimensional vehicle configurations to local analyses of three dimensional viscous laminar flow. Adaptive meshes produced for both steady state and transient problems are to be considered. An important feature of the work is the provision of specialized techniques which can be used at ALB for the development of an integrated fluid/thermal/structural modeling capability. H.A.

N92-27706# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel. **SPECIAL COURSE ON SKIN FRICTION DRAG REDUCTION** Mar. 1992 284 p Course held in Rhode-Saint-Genese, Belgium, 2-6 Mar. 1992; sponsored in cooperation with VKI (AGARD-R-786; ISBN-92-835-0661-8; AD-A253005) Copyright Avail: CASI HC A13/MF A03

Lecture notes for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Skin Friction Drag Reduction' have been assembled in this report. The aim and scope of this course was to provide an overview of the state of the art of current technology programs focused on reducing aircraft drag caused by skin friction. This report provides a review of recent progress in the field of skin friction drag reduction for transport aircraft. It provides a general introduction to the technology and then focuses on two specific aspects of drag reduction: maintaining laminar flow by controlling transition and manipulating the turbulence structure in boundary layers to help reduce skin friction. Technology associated with the use of riblets, LEBU, polymers, additives, etc., is also reviewed.

N92-27707# Centre d'Etudes et de Recherches, Toulouse (France).

BASIC CONCEPTS ON BOUNDARY LAYERS

JEAN COUSTEIX /n AGARD, Special Course on Skin Friction Drag Reduction 39 p Mar. 1992
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At the present time drag reduction is an industrial challenge in aeronautics which justifies the efforts devoted to this topic. One facet of this effort deals with the skin friction drag reduction. Two directions are followed. The first one is the manipulation of turbulent boundary layers, by altering the formation of turbulence or by modifying its characteristics it is hoped to decrease the turbulent skin friction. The second direction concerns the action on laminar-turbulent transition, by delaying the occurrence of the turbulent regime, enormous skin friction reductions are possible. It is believed that the improvements in the field are based on a better knowledge of the basic phenomena. Author

N92-27708# Airbus Industrie, Blagnac (France).

DRAG REDUCTION: AN INDUSTRIAL CHALLENGE

J. P. ROBERT /n AGARD, Special Course on Skin Friction Drag Reduction 15 p Mar. 1992
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Over the last few decades all civil aircraft manufacturers have made great efforts to reduce aircraft drag. The long term aim of the operation is to reduce the specific fuel consumption of aircraft, the potential reduction of over 10 percent would represent savings of several million dollars for the airlines. The fuel crises have increased the need for developing new technologies to be applied on the new aircraft; retrofits, however, also have their uses. Estimating the drag of a transport aircraft through calculation or wind tunnel tests must come as close as possible to the value obtained in flight. H.A.

N92-27711# Centre d'Etudes et de Recherches, Toulouse (France). Dept. of Aerothermodynamics.

BOUNDARY LAYER TRANSITION: PREDICTION, APPLICATION TO DRAG REDUCTION

D. ARNAL /n AGARD, Special Course on Skin Friction Drag Reduction 59 p Mar. 1992

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This paper describes the practical calculation methods which are currently available to predict the transition location in two and three dimensional flows. Emphasis is given to the problem of skin friction drag reduction on swept wings at subsonic and transonic speeds. The so called $e(\sup n)$ method, which is deduced from the linear stability theory is widely used in the case of 'natural' transition, but simpler techniques (empirical criteria) are useful in more complex situations such as boundary layer tripping or leading edge contamination. The simulation of flight in wind tunnels is also discussed. Wind tunnel/flight correlation includes comparisons between the free stream disturbance environment, the transition Reynolds number, and the n factor at transition onset. Author

N92-27714# Centre d'Etudes et de Recherches, Toulouse (France). Aerothermodynamics Dept.

TURBULENT SKIN-FRICTION DRAG REDUCTION BY ACTIVE AND PASSIVE MEANS, PART 1

E. COUSTOLS (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).) and A. M. SAVILL (Cambridge Univ., England) /n AGARD, Special Course on Skin Friction Drag Reduction 80 p Mar. 1992 Sponsored in part by Rolls-Royce Ltd.; Cambridge Univ.; Airbus Industrie; Aerospatiale; British Aerospace Aircraft Group; BACC; and BMT
(Contract SERC-GR/E/06824; SERC-GR/E/77039)

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The purpose of this paper is to provide a current overview of turbulent skin friction drag reduction concepts which have potential for reducing aircraft fuel consumption. These lectures are organized around four topics. First, after briefly reviewing what is known about the structure of the turbulent boundary layer, possible mechanisms for both active and passive will be discussed; concentrating on techniques offering net drag benefits, either through inner or outer layer manipulation. Both experimental and numerical results will be presented for these boundary layer manipulators. Available data and computer model predictions for low and high subsonic speeds, transonic conditions, and supersonic flow will be reviewed. The aim will be to outline the most important results obtained in terms of drag reduction, and to emphasize the most recent developments. Finally, the combination of passive devices with polymers, suction, blowing, microbubbles, or acoustic forcing will be discussed along with studies of alternative drag reducing surfaces. Author

N92-27936# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

TRANSONIC UNSTEADY AERODYNAMICS AND AEROELASTICITY

Mar. 1992 396 p In ENGLISH and FRENCH The 73d meeting was held in San Diego, CA, 7-11 Oct. 1991 Original contains color illustrations
(AGARD-CP-507; ISBN-92-835-0660-X; AD-A253603) Copyright Avail: CASI HC A17/MF A04

Given here are papers presented at a Specialists' Meeting organized by the Structures and Materials Panel of AGARD and held at its Fall 1991 Meeting. Topics covered include transonic unsteady aerodynamics, aeroelasticity, various methods of calculation, and engineering-level aeroelastic prediction techniques.

N92-27940# Saab Aircraft Co., Linkoping (Sweden). Dept. of Aeroelasticity.

RECENT APPLICATIONS OF LINEAR AND NONLINEAR UNSTEADY AERODYNAMICS FOR AEROELASTIC ANALYSIS BENGT WINZELL /n AGARD, Transonic Unsteady Aerodynamics

and Aeroelasticity 10 p Mar. 1992 Sponsored in part by Swedish Defence Administration
Copyright Avail: CASI HC A02/MF A04

Results of unsteady linear and full potential theory are used for analysis of wings and aircraft configurations. In particular, the details of unsteady pressure distributions at the trailing edge are investigated, aiming at better representation of control surface hinge moments. The importance of viscous effects are observed and a comparison between potential theory and Navier-Stokes predictions is made. Author

N92-27942# Rome Univ. (Italy).

A BOUNDARY INTEGRAL FORMULATION FOR UNSTEADY TRANSONIC POTENTIAL FLOWS

U. IEMMA (Rome Univ. (Italy).), F. MASTRODDI (Rome Univ. (Italy).), L. MORINO (Rome Univ. (Italy).), and M. PECORA (Alenia Spazio S.p.A., Rome, Italy) /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 11 p Mar. 1992 Sponsored by Italian Aerospace Research Center
Copyright Avail: CASI HC A03/MF A04

A boundary integral formulation for the analysis of unsteady potential transonic flows around airplanes is presented. The formulation is applied to steady and to unsteady two dimensional and three dimensional configurations under the small perturbation assumption. The results are compared with existing numerical and/or experimental results, and demonstrate that the algorithm is capable of capturing shocks. However, the location predicted appears to be ahead of that predicted by conservative finite difference schemes; nevertheless, considering the preliminary nature of this work, the agreement obtained is quite satisfactory. Author

N92-27943# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. of Aeroelasticity.

COMPARISON OF EULER AND FULL POTENTIAL METHODS FOR UNSTEADY TRANSONIC FLOW CALCULATIONS

R. VOSS and W. WEGNER /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 17 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

Presented here are the results of unsteady transonic flow calculation methods developed at the DLR Institute of Aeroelasticity for oscillating airfoils and wings. The 2D Euler and Full Potential calculations in the nonlinear regime with pronounced shock dynamics at the conventional NACA0012 and the supercritical NLR7301 airfoil show that the unsteady pressure distributions agree well, whereas the unsteady lift and moment curves are not always in good agreement. The 3D results are obtained with a 3D Full potential code and a 3D time linearized TSD method for a swept NACA0012 wing and for a LANN wing, an AGARD standard test wing, both oscillating with small amplitudes. The agreement of the first harmonics of pressure distribution indicates that the time linearized approach may be sufficient for low amplitudes. For higher amplitudes, however, the appearance of pronounced higher harmonics indicates strong nonlinear behavior combined with complicated shock motions. Author

N92-27944# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. of Aeroelasticity.

COMPUTATION OF THE UNSTEADY TRANSONIC 2D CASCADE FLOW BY AN EULER ALGORITHM WITH INTERACTIVE GRID GENERATION

V. CARSTENS /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 14 p Mar. 1992
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Numerical results of a code for computing the unsteady transonic flow in a 2D cascade of harmonically oscillating blades are given. The calculation of the flow field is based on a Euler code using flux vector splitting. After a description of the basic equations and the special numerical techniques applied to the code, results are presented for the first harmonics of pressure, lift, and moment coefficients. For the present investigations, two

basic oscillation modes were chosen: tuned modes where all blades perform oscillations with the same frequency, same amplitude and a constant interblade phase angle, and mistuned modes, where all blades are oscillating with the same amplitude, but with varying frequency from one blade to another. The computed results refer to two standard configurations: a subsonic-transonic turbine cascade and a subsonic-transonic compressor cascade. In the case of tuned bending modes, the theoretical results are compared with the experimental data from the turbine standard configuration. Special attention is directed to the occurrence of aerodynamic instability in the oscillating cascade. It can be shown that the interblade phase angles at which the above mentioned experimental test case shows unstable behavior are generally well-reproduced by the computational results. Author

N92-27945# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

EVALUATION OF AN UNSTEADY IMPLICIT EULER CODE AGAINST TWO AND THREE-DIMENSIONAL STANDARD CONFIGURATIONS

A. BRENNEIS and A. EBERLE /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 15 p Mar. 1992
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The numerical simulation of the unsteady Euler equations in conservative form for time-accurate problems using a relaxation method is considered. The unfactored implicit equations are solved by applying a nonlinear Newton method. Relaxation is performed with a point Gauss-Seidel algorithm ensuring a high degree of vectorization by employing the so-called checkerboard scheme. The fundamental feature of the Euler solver is a characteristic variable splitting scheme (Godunov-type averaging procedure, linear locally one-dimensional Riemann solver) based on an Eigenvalue analysis for the calculation of fluxes. Singular behavior of the coefficient matrix is evaded by a simple matrix conditioning needing only a few operations. Numerical results are presented for two and three dimensional standard AGARD configurations. The airfoils and wings at sub and transonic flows perform harmonically pitching oscillations or trailing edge flap oscillations. Comparisons with experiments show good agreement except in regions where viscous effects are evident. Author

N92-27946# Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid (Spain).

UNSTEADY TRANSONIC AERODYNAMICS OF POINTED BODIES OF REVOLUTION IN SUPERSONIC FREESTREAM

P. GARCIAFOGEDA and A. SANZ /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 9 p Mar. 1992 Sponsored by Polytechnical Univ. of Madrid
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A method was developed to determine the aerodynamic forces acting on oscillating bodies of revolution in transonic-supersonic flight. The nonlinear equation for the mean flow perturbation potential and the time linearized equation for the cross flow perturbation are both of hyperbolic type, for the Mach number range of interest, and have been solved by the method of characteristics. The method is valid for arbitrary frequencies of oscillation and can be applied for rigid or flexible body motions. Results are presented for the stability force coefficients, unsteady pressure distributions, and shock deformations for various body shapes and Mach numbers. Author

N92-27947# National Aerospace Lab., Amsterdam (Netherlands).

NLR INVISCID TRANSONIC UNSTEADY LOADS PREDICTION METHODS IN AEROELASTICITY

M. H. L. HOUNJET /n AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 16 p Mar. 1992 Sponsored in part by Royal Dutch Airforce (Contract NIVR-01904-N)
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An overview is presented of unsteady inviscid calculation methods at the National Aerospace Laboratory (NLR), which are primarily based on the full potential equation for the prediction of

02 AERODYNAMICS

airloads on oscillating structures in transonic flow. Attention is given to experience with entropy/vorticity corrections and a procedure which removes the frequency barrier associated with time-linearized modelings. This procedure has a favorable effect on computer cost such that transonic flutter boundaries can be obtained in acceptable turn-around times on current workstations. A method for transonic aeroelastic analysis of complete aircraft which is now in the stage of development is introduced, and attention is given to its grid generation procedure. The methods are demonstrated by showing results of unsteady loads and pressure coefficients applications in 2D and 3D transonic flow and an aeroelastic application to a 3D AGARD standard aeroelastic case in transonic flow. Author

N92-27948# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany). Numerical Fluid Mechanics Div.

COMPUTATIONS OF UNSTEADY FLOWS AROUND AIRFOIL SECTIONS BY EXPLICIT AND IMPLICIT METHODS SOLVING THE EULER AND NAVIER-STOKES EQUATIONS

EDGAR A. GERTEISEN /in AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 13 p Mar. 1992

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A Euler/Navier Stokes solution algorithm is presented for unsteady aerodynamic analysis of flows around airfoil sections. Several numerical methods have been involved in the flow solver, beginning with an explicit Runge-Kutta time-stepping scheme. Two methodological closely connected moving mesh algorithms were implemented, concerning the mesh adaption for improved accuracy with a minimal number of mesh points, and the body conforming mesh movement which is completely general and can treat realistic configurations. A description is given of the latest version of the developed implicit solving algorithm which can be used as a direct method, but also includes an option for iterating the unsteady residual to enhance the time accuracy. The included moving mesh methods for solution adapting and body conforming the grid are summarized. Numerical simulations of steady and unsteady well known flow phenomena, comprising a shock/boundary interaction, a flow around a cylinder, an airfoil with oscillating flap, and a circular arc airfoil substantiate the above mentioned topics. Author

N92-27949# Deutsche Airbus G.m.b.H., Bremen (Germany). Dept. Aeroelastics.

COMPUTATION OF VISCOUS PHENOMENA IN UNSTEADY TRANSONIC FLOW

U. R. MUELLER, H. HENKE, and K. DAU /in AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 16 p Mar. 1992

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Progress towards the development of a 3D viscous-inviscid strong interaction method for computing unsteady transonic wing flow is reported. In the current version, an ADI technique for solving the 3D unsteady Transonic Small Perturbation (TSP) equation has been extended by incorporating an unsteady 2D integral boundary layer method and then simultaneously solving the viscous and inviscid flow equations in a stripwise fashion. Here attention is focused on the viscous part of the method, and a 3D boundary layer version is introduced. Detailed calculations of 2D unsteady and 3D incompressible/compressible turbulent boundary layers were performed by the integral methods and also by a finite difference solver, and the results are compared to experimental data. The strong interaction technique is validated by comparison with experimental pressure distributions on several airfoils and a wing for various transonic Mach numbers. For steady and unsteady flows, the computed influence of viscous displacement on the pressure distribution is demonstrated in contrast to purely inviscid calculations. Author

N92-27950# British Aerospace Aircraft Group, Kingston-upon-Thames (England). Military Aircraft Div.

TRANSONIC AEROELASTIC CALCULATIONS IN BOTH THE TIME AND FREQUENCY DOMAINS

M. J. KNOTT /in AGARD, Transonic Unsteady Aerodynamics

and Aeroelasticity 8 p Mar. 1992

Copyright Avail: CASI HC A02/MF A04

A method for exploring the flutter characteristics of wing-only configurations in the transonic flow regime is presented. At the heart of the method is the Unsteady Transonic Small Perturbation (UTSP) program, which solves the nonlinear transonic small perturbation equation with or without the simultaneous integration of the structural equations of motion. The aim here is to describe the functionality of the program, with a particular emphasis on its implementation within the existing aeroelastics analysis environment at the Kingston site of British Aerospace. Before demonstrating the use of the UTSP program on a production combat wing, results for the AGARD Taileron and wing 445.6 models are presented, with the aim of validating the method. Author

N92-27952# Deutsche Airbus G.m.b.H., Bremen (Germany). Dept. Aeroelastics.

COMPUTATION OF FLUTTER BOUNDARIES IN THE TIME AND FREQUENCY DOMAIN

H. ZIMMERMANN, S. VOGEL, H. HENKE, and B. SCHULZE /in AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 9 p Mar. 1992

Copyright Avail: CASI HC A02/MF A04

Computations of flutter boundaries in the time and frequency domain are presented using an interactive 3D Transonic Small Perturbation code. Results of conventional flutter calculations in the frequency domain are opposed to those of flutter simulations integrating the aerodynamic and structural equations of motion simultaneously in the time domain. Highlighted here are the basic properties of these two approaches and the results for a six and a two degrees of freedom model. A comparison of generalized airloads determined by harmonic and pulse excitation is presented. Author

N92-27954# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

DIRECT COUPLING OF FLUID STRUCTURE IN TRANSONIC AEROELASTICITY [COUPLAGE DIRECT FLUIDE STRUCTURE EN AEROELASTICITE TRANSSONIQUE]

J. P. GRISVAL and J. L. MEURZEC /in AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 14 p Mar. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A91-16744

Copyright Avail: CASI HC A03/MF A04

Presented here is a numerical approach for transonic aeroelasticity studies called the direct coupling method. This direct coupling is realized between the computation of aerodynamic forces and the computation of displacements. The flow is modeled by using the Transonic Small Perturbation (TSP). In steady flow, we determine the static deformations of the structure. The strong coupling insures the equilibrium state between the aerodynamic forces and the static deformations and in the steady flow between the aerodynamic and the aeroelastic forces in the time domain. The analysis of the resulting displacements give the evolution of the structural modes and enable us to detect flutter. Numerical results are presented for a civil aircraft and are compared with other methods in the frequency domain. Author

N92-27962# Royal Aerospace Establishment, Bedford (England). Aerodynamics Dept.

A REVIEW OF SCALE EFFECTS ON SURFACES IN UNSTEADY MOTION

D. G. MABEY /in AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 19 p Mar. 1992

Copyright Avail: CASI HC A03/MF A04

The importance of scale effects is recognized generally in steady aerodynamics but is often ignored in unsteady aerodynamics. An attempt is made to remedy this situation by the compilation of a review of information on the influence of Reynolds number from a wide range of unsteady aerodynamic tests, with particular reference to wing flows. The unsteady tests considered here relate to surfaces in unsteady motion and include dynamic tests of airfoils and wings, pressure measurements, oscillatory control surface derivatives, and

stability derivatives. Here, it is suggested that for the recommended model conditions with fixed transition, scale effects are small for fully attached or well-separated flows, but may be close to incipient separation. With fixed transition, extrapolation from model to full-scale Reynolds numbers is usually possible. In contrast, with free transition, scale effects can be large for both attached and separated flows, and extrapolation from model to full-scale Reynolds numbers is usually extremely difficult. Some test cases for the prediction of scale effects in unsteady aerodynamics are suggested. Author

N92-28657# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

ANALYSIS OF RESULTS OF AN EULER-EQUATION METHOD APPLIED TO LEADING-EDGE VORTEX FLOW

J. I. VANDENBERG, H. W. M. HOEIJMAKERS, and J. M. J. W. JACOBS 30 Oct. 1990 17 p Presented at the AGARD Fluid Dynamics Panel Symposium on Vortex Flow Aerodynamics, Scheveningen, Netherlands, 1-4 Oct. 1990 Previously announced as N92-13000 Sponsored by Netherlands Agency for Aerospace Programs

(NLR-TP-90368-U; ETN-92-91450) Avail: CASI HC A03/MF A01

The flow about a 65 deg sharp edged cropped delta wing with and without an underwing body is simulated by solving the Euler equations. Results are presented for the wing body configuration at a transonic free stream Mach number at incidences ranging from 10 to 20 deg for which in the flow field above the wing a strong vortex develops as well as shocks for the high incidence of 20 deg. Results for subsonic to transonic free stream Mach numbers at high incidence are obtained for the wing alone configuration for which, in the presence of a strong vortex, at transonic free stream Mach number, shocks appear in the solution. For the wing-body configuration, the computational results are compared with experimental data, and the solution in the near wake is investigated. ESA

N92-28658# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

COMPARISON OF LDA AND LTA APPLICATIONS FOR PROPELLER TESTS IN WIND TUNNELS

J. H. M. GOODEN and J. W. KOOL 7 May 1988 10 p Presented at the 4th International Symposium on Applications of Laser Anemometry to Fluid Mechanics, Lisbon, Portugal, 11-14 Jul. 1988 Previously announced in IAA as A89-33381 (Contract NIVR-03601-N)

(NLR-MP-88031-U; ETN-92-91512) Avail: CASI HC A02/MF A01

A study to investigate the performance of a two component Laser Doppler (LDA) and Laser Transit (LTA) Anemometer is presented. Both systems were compared under industrial testing conditions in the flow field of a propeller. Free stream flow speed was 40 m/s. The propeller, diameter 0.73 m, was operated at 3500 and 6000 rpm. Axial and tangential velocities were measured in front of, in between and behind the propeller blades. The results of the two systems were in good agreement within 1 m/s for the axial velocity. The error in the tangential velocity was about 1 to 2 m/s but of a different sign. The productivity and the capability of the LDA to measure in highly turbulent flows were superior. The high light concentration in the probe volumes of the LTA made artificial seeding superfluous. ESA

N92-28659# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

CALCULATION OF UNSTEADY SUBSONIC AND SUPERSONIC FLOW ABOUT OSCILLATING WINGS AND BODIES BY NEW PANEL METHODS

M. H. L. HOUNJET 14 Apr. 1989 24 p Presented at the European Forum on Aeroelasticity and Structural Dynamics, Aachen, Fed. Republic of Germany, 17-19 Apr. 1989 Previously announced in IAA as A90-33359 Sponsored in part by Royal Netherlands Air Force

(NLR-TP-89119-U; ETN-92-91518) Avail: CASI HC A03/MF A01

The unsteady aerodynamic loads in the subsonic and supersonic domain, obtained with two new panel methods, for lifting surfaces

and for realistic aircraft configurations are presented. The General Unsteady Lifting (GUL) surface code and the Compressible Aerodynamic Response (CAR) methods were developed for calculations involving realistic aircraft configurations. A description of the methods is given. Results are presented and comparisons are made with results of existing methods and with experimental data for a fighter type wing with external stores. ESA

N92-28660# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

CONSTRAINED SPANLOAD OPTIMIZATION FOR MINIMUM DRAG OF MULTI-LIFTING-SURFACE CONFIGURATIONS

R. F. VANDENDAM 10 Apr. 1989 19 p Presented at the AGARD Specialists Meeting on Computational Methods for Aerodynamic Design (Inverse) and Optimization, Loen, Norway, 22-23 May 1989

(Contract NIVR-01101-N)

(NLR-TP-89126-U; ETN-92-91519) Avail: CASI HC A03/MF A01

The development of a interactive computer program system that can be used in aircraft drag minimization studies is addressed. It comprises algorithms for choosing the spanwise distributions of lift, pitching moment, chord and thickness to chord ratio of lifting elements. The choices are optimal in that they minimize induced plus viscous drag while satisfying constraints of aerodynamic, flight mechanical and structural natures. The configurations that can be dealt with may consist of a number of segments representing, for instance, wings or parts of wings, horizontal tails or canards, winglets, flap-rail-fairings, etc. Also the interaction between propellers and lifting elements may be included in the procedure. The induced drag is computed using the Trefftz plane integral (farfield analysis), while the viscous drag follows from form factor methods. Novel mathematical formulations of the constrained optimization problems based on the calculus of variations are used. The method was integrated in an infrastructure that allows the capabilities of the method to be efficiently exploited in a multidisciplinary environment. The theoretical models and methods underlying the analysis and optimization capability, comparisons with other theories, information aspects, and some examples of applications are presented. ESA

N92-28692# National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Div.

DEVELOPMENT AND VALIDATION OF A CHARACTERISTIC BOUNDARY CONDITION FOR A CELL-CENTERED EULER METHOD

J. I. VANDENBERG and J. W. BOERSTOEL 6 May 1990 12 p Presented at the 17th ICAS Congress, Stockholm, Sweden, 9-14 Sep. 1990 Sponsored in part by Netherlands Agency for Aerospace Programs

(NLR-TP-90144-U; ETN-92-91535) Avail: CASI HC A03/MF A01

The development and numerical validation of a solid wall boundary condition for the numerical solution of the Euler equations with a cell centered central difference scheme is presented. This solid wall boundary condition was obtained from the theory of characteristics, and was also formulated for a cell/centered central/difference scheme. The boundary condition was developed to clarify the question of what the effect is of various boundary/condition algorithms on the accuracy of the three dimensional numerical solution of the Euler equations. The numerical validation of the solid/wall boundary condition consists of a comparison of results obtained with the conventional and the new solid/wall boundary condition. Discretization and convergence errors as well as grid dependency of the solution were investigated. As a test case, the NLR 7301 airfoil was chosen. Calculations were performed for the supercritical, shock free flow at $M(\text{sub infinity}) = 0.721$, $\alpha = 0.194$ deg, and for a flow with a strong shock at $M(\text{sub infinity}) = 0.70$, $\alpha 2.0$ deg. ESA

N92-28709# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

WAVE DRAG DETERMINATION IN THE TRANSONIC FULL-POTENTIAL FLOW CODE MATRICES

J. VANDERVOOREN and A. J. VANDERWEES 19 Feb. 1990

32 p

(Contract NIVR-RB-311.1-01501-N)

(NLR-TP-90062-U; ETN-92-91530) Avail: CASI HC A03/MF A01

The mathematical background of a method developed to calculate wave drag in transonic potential flow is described. The method is a generalization and extension of Garabedian's and McFadden's idea of determining wave drag by volume integration of the artificial viscosity. The generalization of Garabedian's and McFadden's idea involves the introduction of a reference artificial viscosity which provides a solid theoretical basis. At the same time this ensures that calculated wave drag is to a certain extent independent of the specific details of the artificial viscosity in different diodes. The extension of Garabedian's and McFadden's idea accounts for the fact that artificial viscosity does not smear out supersonic/subsonic shock waves completely, but leaves room for a truly discontinuous sonic/subsonic 'shock remainder' that contributes substantially to the wave drag. Both fully conservative and nonconservative shock capture in potential flow are covered. The method can be extended to handle also pseudo Rankine-Hugoniot shock waves. An illustrative example for a transonic transport type wing is given. ESA

N92-28789# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de l'Aérodynamique. **FEASIBILITY STUDY OF HYPersonic CLINOMETRIC MEASUREMENTS AT R3CH Final Summary Report [ETUDE DE FAISIBILITE DE MESURES CLINOMETRIQUES EN HYPersonIQUE A R3CH. RAPPORT DE SYNTHESE FINAL]** M. C. MERIENNE and M. ALAPHILIPPE Jun. 1991 46 p In FRENCH

(Contract DRET-89-34-001)

(ONERA-RSF-136/1865-AY-728-A; ETN-92-91327) Avail: CASI HC A03/MF A01

The feasibility of clinometric measurements in hypersonic flow was investigated, by a miniaturized probe with five holes, in a R3Ch wind tunnel. The phases of the study were: estimation of the response time, the design, the calibration, and the measurements on a flat plate. The probe, with one end of 2 mm diameter, has a short response time and a high thermal resistance. The clinometric calibration performed under an incidence angle, between -4 and +4 degrees, shows a sensibility coefficient of the probe with a 4 maximal uncertainty, which represents a measurement error between 0.3 and 0.7 degrees. ESA

N92-29159# European Space Agency, Paris (France). **CALCULATION OF SUPPORT INTERFERENCES ON THE AERODYNAMIC COEFFICIENTS FOR A WIND TUNNEL CALIBRATION MODEL [BERECHNUNG DER SUPPORT-INTERFERENZEN FUER DIE AERODYNAMISCHEN BEIWERTE EINES WINDKANAL-EICHMODELLS]**

DIETER STEINBACH (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Feb. 1992 78 p Transl. into ENGLISH of German document (Goettingen, Fed. Republic of Germany, DLR), May 1990 p 1-63 Original language document was announced as N91-15998 (ISSN 0171-1342)

(ESA-TT-1247; DLR-FB-90-26; ETN-92-91207) Avail: CASI HC A05/MF A01; Original German Version available from DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, Cologne, Fed. Republic of Germany, 23 DM

Model support interferences are calculated in the form of corrections to the aerodynamic coefficients for a calibration model to be tested in a subsonic cryogenic wind tunnel. Two different model support systems are investigated: a horizontal sting (rear sting) and a vertical sting (ventral sting). The results of earlier experiments using these configurations already exist and the corrections obtained in the present work are therefore applied to these measurements for verification. In addition, the effect of the sting on the static longitudinal stability of the model is investigated in more detail. A three dimensional panel method is used for the calculations. This permits the simultaneous calculation of thickness and lift effects when several bodies of almost any given shape

are present in the flow. The aerodynamic coefficients are obtained by numerical integration of the surface pressure distribution on the model. ESA

N92-29206# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de l'Aérodynamique. **DEVELOPMENT OF AN UNSTEADY THREE-DIMENSIONAL VISCOUS-INVISCID INTERACTION NUMERICAL METHOD FOR THE CALCULATION OF AIRFOILS VIBRATION Final Summary Report [DEVELOPPEMENT D'UNE METHODE NUMERIQUE D'INTERACTION VISQUEUX-NON VISQUEUX TRIDIMENSIONNELLE INSTATIONNAIRE POUR LE CALCUL DU TREMBLEMENT DES VOILURES. RAPPORT DE SYNTHESE FINALE]**

P. GIRODROUX-LAVIGNE and J. C. LEBALLEUR Sep. 1991 44 p In FRENCH

(Contract STPA-85-95-009)

(ONERA-RSF-7/3617-AY-022A; ETN-92-91325) Avail: CASI HC A03/MF A01

A study to predict the transonic vibration occurring in airfoils of a carrier aircraft is presented. The study was focused on the numerical technique of an inverse three dimensional unsteady boundary layer, as well as on the semi implicit unsteady coupling algorithm. The numerical results give a first approach of the coupling methods and the calculation of three dimensional separation, and restored the topology of the friction lines. The calculations were firstly performed for a subsonic flow in the following geometry conditions: a flat plate containing a wall hole with a very high three dimensionality. A separation through a transonic right wing type NACA0012 was predicted. ESA

N92-29648# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

TECHNOLOGY PROGRAMME: AEROTHERMODYNAMICS AND PROPULSION INTEGRATION. NUMERICAL AND EXPERIMENTAL AEROTHERMODYNAMICS

E. H. HIRSCHEL 26 Aug. 1991 13 p Presented at the Review of the German Hypersonic Research and Technology Programme, Bonn, Fed. Republic of Germany, 16-17 Apr. 1991 (MBB-FE-202-S-PUB-0464-A; ETN-92-91497) Copyright Avail: CASI HC A03/MF A01

Work performed in the fields of 'aerothermodynamic predesign methods (approximate methods)', 'numerical methods of aerothermodynamics' and 'experimental methods of aerothermodynamics' is reviewed. The objective of the work is sketched, major results are listed, examples are given and future efforts are outlined. The examples include applications of predesign methods and numerical methods for the determination of global forces and moments, aerodynamic loads and heat loads (for the latter also a study of the influence of different flow physical model assumptions). From the field of experimental aerothermodynamics, an application of a fluorescence method is given, and the picture of a wind tunnel model is shown in order to demonstrate the complexity of such test articles. At the middle of phase 1 of the technology program, basic aerothermodynamic design tools and methods are available, which will reach the first validation level at the end of phase 1. Large deficiencies in flow physical models (transition laminar-turbulent, turbulence, etc.) were identified and basics oriented and applications oriented work was initiated at universities and research establishments. Thus, work will help the second validation level, which is needed when the development of the Saenger space transportation systems begins. ESA

N92-29649# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Unternehmensbereich Flugzeuge.

AEROTHERMODYNAMICS AND PROPULSION INTEGRATION IN THE SAENGER TECHNOLOGY PROGRAMME

E. H. HIRSCHEL 16 Sep. 1991 12 p Previously announced in IAA as A92-17829

(MBB-FE-202-S-PUB-0469-A; AIAA PAPER 91-5041;

ETN-92-91499) Copyright Avail: CASI HC A03/MF A01

The objectives of the technology program 'aerothermodynamics and propulsion integration' are defined. An overview of the special

aerothermodynamic phenomena which must be regarded in the design of the Saenger lower stage, which presently stands in the center of the technology program, is given. The design tools, which must be provided, the components like the inlet, and the afterbody, which must be designed and tested, and the special problems like forebody optimization, heat load determination, and upper stage separation, which must be treated, are discussed. The general work plan, with the major activities up to the start of the development of the Saenger space transport system is presented, including the development and manufacturing of an experimental vehicle (HYTEX) as a means for the validation of the design tools and methods which are achieved in the technology program, and for the creation of a free flight data base. Examples given include applications of pre-design methods and numerical methods for the determination of global forces and moments, aerodynamic loads and heat loads, for the latter also a study of the influence of different flow physical model assumptions. Results from the inlet study, the stage separation study, etc., show the advancement in these areas. ESA

N92-29713# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Unternehmensbereich Flugzeuge.

HYPERSONIC FLOW PAST RADIATION-COOLED SURFACES

E. H. HIRSCHL, A. KOC, and S. RIEDELBAUCH (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.G.) 16 Sep. 1991 10 p Previously announced in IAA as A92-17821

(MBB-FE-202-S-PUB-0468-A; AIAA PAPER 91-5031; ETN-92-91498) Copyright Avail: CASI HC A02/MF A01

Hypersonic vehicles employ surface radiation cooling in order to reduce heat loads. The radiation adiabatic surface temperature is the result of the balance of the heat conduction towards the surface and the heat radiated away from the surface, if no heat transport into the surface occurs. It is shown by means of a local analysis that the radiation adiabatic temperature depends, other than the recovery temperature, on a characteristic boundary layer thickness. The state of the boundary layer (laminar or turbulent) has a much larger influence on the radiation adiabatic temperature than on the recovery temperature. The local analysis explains, for example, why hot spots appear along attachment lines. With the classical wind tunnel simulation techniques the radiation adiabatic temperature cannot be determined. A 'hot experimental technique' is needed if an accurate determination of heatloads in the presence of radiation cooling is desired. It involves a duplication or near duplication of Mach and Reynolds number, total temperature, and a model surface in radiation adiabatic equilibrium. The length scale dependency of the radiation adiabatic temperature then makes a scaling to full size necessary. This is shown to be possible for laminar flow, but not yet for turbulent flow. ESA

N92-29741# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Fakultae fuer Luft- und Raumfahrttechnik.

A SEMI EMPIRICAL METHOD FOR THE ANALYTICAL REPRESENTATION OF STATIONARY MEASURED PROFILE COEFFICIENTS FOR APPLICATIONS OF ROTARY WING AERODYNAMICS Ph.D. Thesis [EINE HALBEMPIRISCHE METHODE ZUR ANALYTISCHEN DARSTELLUNG STATIONAAR GEMESSENER PROFILBEIWERTE FUER ANWENDUNGEN DER DREHFLUEGLERAERODYNAMIK]
MANFRED LERCH 1990 190 p In GERMAN
(ETN-92-91491) Avail: CASI HC A09/MF A02

The semi empirical process presented is used for the closed representation of aerodynamic coefficients, from the point of view of flow conditions occurring in rotor blades. The aerodynamic coefficients are formulated analytically in the model as a function of the inflow components. Analytical functions are presented on the basis of the superposition principle. They reproduce the various flow conditions by simple theoretical and empirical formulations. The superposition of these functions leads to a qualitatively accurate representation of the aerodynamic coefficients. On the basis of the quaternions transformation, a mechanical auxiliary model was developed for the computation of the motion behavior of helicopter rotors. ESA

N92-29884# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

EVALUATION OF MEASURED-BOUNDARY-CONDITION METHODS FOR 3D SUBSONIC WALL INTERFERENCE

T. E. LABRUJERE, T. A. MAARSINGH, and J. SMITH 31 Mar. 1988 102 p

(NLR-TR-88072-U; ETN-92-91547) Avail: CASI HC A06/MF A02

Measurements of a simple aircraft model on both an appropriately sized and a relatively large, low/speed, solid/wall test section were used to analyze the accuracy and consistency of Measured/Boundary/Condition (MBC) methods. For completeness, the classical method of images, with two different correction procedures, was also analyzed. For the MBC methods, large reductions in the amount of in situ measured boundary data turn out to be possible, while almost retaining the accuracy obtained from abundant boundary data. In addition, high computing efficiency was achieved allowing on line wall interference assessment and correction during a wind tunnel test. The classical assessment methods turns out to be competitive with the MBC methods for the mode and test conditions considered (CL less than or equal to 2, no massive flow separation). Its applicability is limited, like any method requiring a theoretical representation of the mode flow. Some attention was paid to the definition of the reaction of the model to the wall/induced velocity field, i.e., the correction procedure. The analyses suggest that improvements and/or adaptations are desirable. ESA

N92-29889# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Fakultae fuer Luft- und Raumfahrttechnik.

PRODUCTION OF PERIODICAL MACH NUMBER VARIATIONS IN HIGH SUBSONIC FLOW IN A BLOW DOWN WIND TUNNEL, AND ITS INFLUENCE ON PROFILE MEASUREMENTS Ph.D.

Thesis [ERZEUGUNG PERIODISCHER MACHZAHLAENDERUNGEN IN HOHEN UNTERSCHALL IN EINEM BLOW-DOWN-WINDKANAL UND IHR EINFLUSS AUF DIE PROFILMESSUNGEN]

ROBERT SPELTEN 1990 138 p In GERMAN

(ETN-92-91492) Avail: CASI HC A07/MF A02

The properties of unsteady flow in a blow down wind tunnel are described. A follow up system allows the Mach number variations to be correlated from two channel gage lengths. It is determined that transonic profile flows display strong dynamic attenuation phenomena for the transmission of the mass flow stimulation. A process based on the measured Mach number variations was developed, according to which the representative Mach numbers can be theoretically determined for the model. The model developed is to be used for other two and three dimensional models. ESA

N92-30514# European Space Agency, Paris (France).

COMPUTATION OF UNSTEADY TRANSONIC FLOWS USING AN IMPLICIT CENTERED EULER SOLVER WITHOUT ARTIFICIAL VISCOSITY

ANNE-SOPHIE SENS (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) Mar. 1992 105 p Transl. into ENGLISH of Calcul d'Ecoulements Transsoniques Instationnaires par Resolution Implicite Centree des Equations d'Euler sans Viscosite Artificielle (Paris, France, ONERA), Sep. 1990 98 p Original language document was announced as N91-12633 (ESA-TT-1235; ONERA-NT-1990-8; ETN-92-91709) Avail: CASI HC A06/MF A02

The numerical simulation of unsteady transonic flows is presented. The solution of the Euler equations using an extension of Lerat's second order accurate, centered implicit scheme is used. When applied as an unsteady method for determining steady solutions, the scheme has the advantage of working without artificial viscosity, and the aim of this study is to extend this property to the case of truly unsteady problems. The approximations are developed in one dimension. The two timestep scheme is extended to two dimensions following the approach of Lerat and Sides for the steady case. A stability result on the scalar case is given. The method is applied to the computation of the unsteady transonic flow around an airfoil in rigid body motion. A three dimensional

02 AERODYNAMICS

validation of the two timestep method is proposed for the problem of the swept wing oscillating in translation between parallel walls.

ESA

N92-30676# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CFD CONTRIBUTIONS DURING HYPERSONIC AIRPLANE INTAKE DESIGN

N. C. BISSINGER and A. EBERLE Jul. 1991 28 p (MBB/FE213/S/PUB/459; ETN-92-91907) Copyright Avail: CASI HC A03/MF A01

Numerical elements of an advanced Computational Fluid Dynamics (CFD) code regarding computational speed and accuracy are addressed. With increasing Mach number of high speed vehicles there is a growing need for the design people to get information on the steadily growing complexity of the flows outside and inside these airplanes. Results of several calculations performed to gain insight into the flow in hypersonic intakes are presented.

ESA

N92-30713# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

MATGRID, A PROGRAM FOR GENERATION OF C-H AND C-O TOPOLOGY GRIDS AROUND WING/BODY CONFIGURATIONS: SOFTWARE DESCRIPTION DOCUMENT

LARS G. TYSELL and SVEN G. HEDMAN Dec. 1991 101 p Sponsored by Swedish Board for Technical Development (FFA-TN-1990-20; ETN-92-91704) Avail: CASI HC A06/MF A02

The software description of MATGRID is given. MATGRID is a computer program for generation of C-H or C-O topology grids for the discretization of flow fields around configurations consisting of a wing alone or a wing and a fuselage. MATRICS (Multicomponent Aircraft Transonic Inviscid Computation System) and MATGRID together form a system of computer programs for the calculation of the flow at cruise condition around wing/body combinations of the type of commercial airliners. The general layout of the program and all major subroutines are described. Also included are subroutines, common block and file cross reference lists, an installation guide, a user's guide, and a mathematical definition document.

ESA

N92-30947# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel. **VORTEX FLOW AERODYNAMICS [L'AERODYNAMIQUE DES ECOULEMENTS TOURBILLONNAIRES]**

J. H. B. SMITH (Royal Aircraft Establishment, Farnborough, England), J. F. CAMPBELL (National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.), and A. D. YOUNG, ed. Apr. 1992 27 p Presented at the Fluid Dynamics Panel Symposium, Scheveningen, The Netherlands, 1-4 Oct. 1990 (AGARD-AR-299; ISBN-92-835-0670-7) Copyright Avail: CASI HC A03/MF A01

The principal emphasis of the meeting was to be on the understanding and prediction of separation-induced vortex flows and their effects on vehicle performance, stability, control, and structural design loads. This report shows that a substantial amount of the papers covering this area were received from a wide range of countries, together with an attendance that was even more diverse. In itself, this testifies to the current interest in the subject and to the appropriateness of the Panel's choice of topic and approach. An attempt is made to summarize each paper delivered, and to relate the contributions made in the papers and in the discussions to some of the important aspects of vortex flow aerodynamics. This reveals significant progress and important clarifications, but also brings out remaining weaknesses in predictive capability and gaps in understanding. Where possible, conclusions are drawn and areas of continuing concern are identified.

Author

N92-31508# Laboratoire d'Aerothermique du CNRS, Meudon (France).

FLAT PLATES PLACED IN DEPLETED HYPERSONIC FLOW [PLAQUES PLANES PLACEES EN ECOULEMENTS HYPERSONIQUES RAREFIES: ANNEXE]

J. ALLEGRE (Societe d'Etudes et de Services pour Souffleries et Installations Aerothermodynamiques, Paris, France), M. RAFFIN (Societe d'Etudes et de Services pour Souffleries et Installations Aerothermodynamiques, Paris, France), J. C. LENGREND, A. CHPOUN (Institut Univ. de Technologie, Evry, France), and L. GOTTESDIENER (Paris VI Univ., France) Mar. 1991 41 p In FRENCH

(Contract DRET-88-521)

(SESSIA-430/91.960; CNRS-RC-91-1; ETN-92-91319) Avail:

CASI HC A03/MF A01

The present volume is the annex of the project's final report. It contains the experimental data obtained during wind tunnel tests. The purpose of the project was to measure the heat flow and the wall pressure of flat plates under hypersonic flow and low Reynolds number. Experimental and theoretical data, calculated by the Monte Carlo and Navier-Stokes methods, were compared. The three flow conditions were characterized by a Mach number approximately equal to 20 and Reynolds (Re) number equal to 2850, 8380, and 72770. Good agreement was observed between the theoretical and experimental values in the following cases: for Re = 2850, the best approach was the direct simulation Monte Carlo; for Re = 8380 and 72770, the best approach was obtained by the Navier Stokes method.

ESA

N92-31514# Cranfield Inst. of Tech., Bedford (England). College of Aeronautics.

AN INVESTIGATION INTO THE INTERFACE BETWEEN THREE CLOSELY SPACED AXI-SYMMETRIC BODIES AT SUBSONIC SPEED

D. I. T. P. LLEWELYN-DAVIES Sep. 1991 200 p Sponsored by RAE/Defence Research Agency, Farnborough, England (CRANFIELD-AERO-9114; ISBN-1-871564-387; ETN-92-91727) Avail: CASI HC A09/MF A03

An experimental investigation into the interference effects present between three closely spaced bodies, over a range of 0 to 6 deg of either pitch or yaw, is presented. Detailed C(sub p) (pressure coefficient (p-p0(q))) distributions were obtained over the bodies and these were successively integrated to obtain the loading distribution along the bodies and the overall forces and moments. By analysis of contour maps representing the C(sub p) distribution over the bodies, the loading diagrams, and the overall loads, the extent of the interference regions and their effect on the aerodynamic characteristics of the bodies were determined. A panel method was used to estimate the C(sub p) distributions over the bodies and, as previously, the loading distributions along the bodies and the overall forces. Estimates were also made of the characteristics of the bodies when the attitude of the body combination was varied between 0 and -6 deg pitch, and when yaw was varied between 0 and +6 deg at pitch angles of +6 and -6 deg.

ESA

N92-32479 ESDU International Ltd., London (England).

AERODYNAMIC CENTRE OF WING-BODY COMBINATIONS

Abstract Only

Jul. 1992 17 p (ISSN 0141-397X)

(ESDU-92024; ISBN-0-85679-829-0) Avail: ESDU

ESDU 92024 applies to a parallel-sided axisymmetric body with a truncated rear-end and a straight-tapered mid-set wing in subsonic or supersonic flow at low angles of attack. The wing may have moderate trailing-edge sweep of up to 10 degrees. The calculation of the aerodynamic center requires the pitching-moment-curve slope for the body alone (for which ESDU 89008 or 90034 may be used), the wing-alone lift-curve slope (for which at subsonic speeds ESDU 70011 may be used or supersonically ESDU 70012), and the lift-curve of the configuration together with interference factors for the effect of body-lift on the wing and wing-lift on the body (for which ESDU 91007 may be

used). The other quantity required is the aerodynamic center of the interference load, for which this document provides both graphically and as a complete set of equations the required data. For missile-type configurations the method is accurate to within 2 percent of body length. The use of the method is illustrated by means of a fully worked example. For configurations with smoothly tapered afterbodies, such as found on transport aircraft, ESDU 76015 provides a method for subcritical speeds. ESDU

N92-32673# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

MODELING AND NUMERICAL SIMULATION OF VORTEX FLOW IN AERODYNAMICS

H. W. M. HOEIJMAKERS 15 Dec. 1990 53 p Presented at the AGARD Fluid Dynamics Panel Symposium on Vortex Flow Aerodynamics, Scheveningen, Netherlands, 1-4 Oct. 1990 Previously announced as N92-12997 Sponsored by Netherlands Agency for Aerospace Programs (NLR-TP-91154-U; ETN-92-92000) Avail: CASI HC A04/MF A01

A review of mathematical models of different levels of approximation for and their application to the numerical simulation of vortical type of flows occurring in subsonic and transonic aircraft aerodynamics is presented. Computational methods for predicting the downstream development of vortex wakes as well as methods for simulating the detailed characteristics of configurations with leading edge or body vortices are covered with the emphasis on the latter. Developments of the methods used at present are discussed. The possibilities, limitations and prospects of improvement of the methods are indicated and results of different methods are discussed. Some more fundamental aspects of the numerical simulation such as separation at sharp and round leading edges, separation at a smooth part of the surface, the structure of the leading edge vortex and the merging of the vortices, are considered. ESA

N92-32730# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

NEW CONCEPTS FOR MULTI-BLOCK GRID GENERATION FOR FLOW DOMAINS AROUND COMPLEX AERODYNAMIC CONFIGURATIONS

S. P. SPEKREIJSE, J. W. BOERSTOEL, and P. L. VITAGILANO (Alenia Spazio S.p.A., Naples, Italy) 15 Feb. 1991 17 p Presented at the 3rd International Conference on Numerical Grid Generation in Computational Fluid Mechanics and Related Fields, Barcelona, Spain, 3-7 Jun. 1991 Previously announced in IAA as A92-47079 (Contract NIVR-01604-N)

(NLR-TP-91046-U; ETN-92-91994) Avail: CASI HC A03/MF A01
A multiblock grid generation procedure that is suitable for the construction of multiblock grids for numerical simulations of flows around complex aerodynamic configurations is described. The major new concepts are topology and geometry of block decomposition specified first by an interactive domain model, the use of compound edges and faces, grid embedding, grid lines only C continuous over block faces, and the use of a biharmonic solver for grid generation in faces. ESA

N92-32732# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

AN EXPERIMENTAL STUDY OF THE FLOW OVER A SHARP-EDGED DELTA WING AT SUBSONIC AND TRANSONIC SPEEDS

A. ELSENAAR and H. W. M. HOEIJMAKERS 28 Feb. 1991 25 p Presented at the AGARD Fluid Dynamics Panel Symposium on Vortex Flow Aerodynamics, Scheveningen, Netherlands, 1-4 Oct. 1990 Previously announced as N92-13011 Sponsored by Netherlands Agency for Aerospace Programs (NLR-TP-91117-U; ETN-92-91997) Avail: CASI HC A03/MF A01

The flow about a sharp edged cropped delta wing is investigated experimentally. The experiment comprised detailed surface pressure measurements at low subsonic, transonic and low supersonic freestream Mach numbers for angles of attack up to 27 deg. The major part of the measurements were carried out at

a Reynolds number of 9 million, but some data was also obtained at lower and at higher Reynolds numbers. The investigation included continuous schlieren flow field visualization as well as surface flow visualizations at a limited number of free stream conditions. The analysis of the measured data embraced flow field phenomena such as primary separation and the formation of the leading edge vortex, secondary separation and the formation of the secondary vortex, shock waves and the onset of vortex breakdown. The influence of Mach number, incidence and Reynolds number on these flow features is considered. ESA

N92-32769# Institut de Mecanique de Grenoble (France). **NUMERICAL SIMULATION OF TURBULENCE AT THE BACK OF THE AIRPLANE Final Report [SIMULATION NUMERIQUE DE LA TURBULENCE DANS LES ARRIERE-CORPS. RAPPORT FINAL]**

M. LESIEUR 1991 39 p In FRENCH

(Contract DRET-89-204)

(ETN-92-91664) Avail: CASI HC A03/MF A01

Numerical experiments for a two dimensional flat jet and for a three dimensional circular jet were performed. The results revealed that the effect of compressibility, and of the density gradient on the initial flow profile produce, during the formation of the first vortices, the same effects as those observed in the case of the two dimensional mixture layer. It was also observed that the cold jet develops more rapidly than the hot jet, and that when the Mach number increases, the time required to form and to develop vortices increases. After the formation of the Karman vortex street, the description of the flat jet as a double mixture layer is not justified. The compression zones tend to disappear. Shocks were observed for $M(\text{sub } r) = 2.5$. In the circular jet experiment, a helical mode was observed. From $M(\text{sub } r) = 0.6$ to $M(\text{sub } r) = 2$, the time required to observe the first helical structures and the wavelength of the fundamental mode are two fold. Following the development structures, the flow becomes locally turbulent and an energy cascade at $(K(\text{sub } x)\text{exp } -5/3)$ is established. A simulation study is carried out at high Reynolds number for the three dimensional circular jet at 0.6 Mach number. ESA

N92-32773# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.

RESEARCH ON SOME CENTERED IMPLICIT METHODS FOR CALCULATING TRANSONIC FLOWS BY SOLVING NAVIER-STOKES EQUATIONS Final Summary Report [RECHERCHES SUR DES METHODES IMPLICITES CENTREES POUR LE CALCUL D'ECOULEMENTS TRANSSONIQUES A PARTIR DE LA RESOLUTION DES EQUATIONS DE NAVIER-STOKES. RAPPORT DE SYNTHESE FINAL]

SYLVIE PLOT-LOCATELLI Oct. 1991 59 p In FRENCH (Contract DRET-89-34-001)

(ONERA-RSF-24/1408-AY-150A; ETN-92-91671) Avail: CASI HC A04/MF A01

The development and operation of a simplified implicit phase, occurring during the solution of two dimensional Navier-Stokes equations, are presented. The equations to be solved and the resolution method are described. The numerical calculation of the implicit phase is presented. Two cases involving turbulent transonic flows are studied. The improvement of the accuracy concerning the convergence towards a steady solution was tested. These results and those from the explicit code are compared, with and without multiple grid accelerators. The time required by the central processing unit to calculate the converging solution by using the implicit method is: equal to 3, when compared to the explicit method with multiple grid phases; and of about 1.4 when compared to the explicit method with multiple grid phase. ESA

N92-32782 ESDU International Ltd., London (England). **LIFT AND ROLLING MOMENT DUE TO SPOILERS ON WINGS WITH TRAILING-EDGE FLAPS DEFLECTED AT SUBSONIC SPEEDS**

1 Jan. 1992 16 p Supplement to ESDU-90030

02 AERODYNAMICS

(ISSN 0141-397X)

(ESDU-92002-SUPPL; ESDU-90030; ISBN-0-85679-807-X) Avail: ESDU

ESDU 92002 provides an empirical method of estimating the lift and rolling moment due to upper-surface spoiler deflection on a wing with flaps deployed. The method is to determine the additional decrement over that obtained when the spoiler is deflected on the plain wing (calculated using ESDU 90030) and the corresponding change in rolling moment. The method applies to the same range of wing planform and spoiler parameters as the methods of 90030 for plain, single- or double-slotted flaps having flap/wing chord ratio of 0.2 to 0.4 and with flap deflections up to 60 degrees. It applies for practical Reynolds number and Mach number up to 0.25, although it will apply up to Mach numbers of 0.5 for flap deflections of 10 degrees or less. From a comparison with test data, the method predicts total lift coefficient decrement within 0.1 and total rolling moment coefficient within 0.01 with no venting from the lower to the upper wing surface. Some guidance is included on the effect of venting, which can increase spoiler effectiveness by 30 percent for large spoiler deflections. Two worked examples illustrated the use of the data. ESDU

N92-32800# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique. **EXPERIMENTAL STUDY OF THE VORTEX SYSTEM GENERATED BY A MISSILE FUSELAGE AT INCIDENCE. PART 3: THREE DIRECTIONAL LASER VELOCIMETRY MEASUREMENTS [ETUDE EXPERIMENTALE DU SYSTEME TOURBILLONNAIRE ENGENDRE PAR UN FUSELAGE DE MISSILE EN INCIDENCE. TROISIEME PARTIE: MESURES PAR VELOCIMETRIE LASER TRI DIRECTIONNELLE]** P. MOLTON and D. BARBERIS Mar. 1991 35 p In FRENCH (Contract DRET-89-34-001) (ONERA-RT-47/1147-AY-146A-PT-3; ETN-92-92082) Avail: CASI HC A03/MF A01

Results of experiments carried out in a supersonic wind tunnel to validate a three dimensional vortex flow calculation code are presented. The three velocity components and the Reynolds stress components for $Mach(\infty) = 2$ were determined. Flow distribution visualizations were achieved by laser tomography in seven planes in order to determine the problems of laser velocimetry measurements. For comparison with the preceding tests, wall flow visualization and wall pressure measurements were carried out for an incidence angle of 20 deg. The results were compared with measurements with a five hole probe of the preceding tests. ESA

N92-70249 National Aerospace Lab., Amsterdam (Netherlands). **SAMID, AN INTERACTIVE SYSTEM FOR AIRCRAFT DRAG MINIMIZATION STUDIES: MATHEMATICAL MODELS AND METHODS**

R. F. VANDENDAM 8 May 1988 62 p Sponsored in part by Nederlands Inst. voor Vliegtuigontwikkeling en Ruimtevaart, Delft (PB91-219444; NLR-TR-88071-U; AD-B155452L) Avail: CASI HC A04/MF A01

An interactive computer program system was developed that can be used in aircraft drag minimization studies. It comprises algorithms for choosing the spanwise distributions of lift, pitching moment, chord and thickness to chord ratio of lifting elements. The choices are optimal in that they minimize induced plus viscous drag while satisfying constraints of an aerodynamic, flight-mechanical, and structural nature. The configurations that can be dealt with may consist of a number of segments representing, for instance, wings or parts of wings, horizontal tails or canards, winglets, flap-trail-fairings, etc. The induced drag is computed using the Trefftz-plane integral (farfield analysis), while the viscous drag follows from form factor methods. Novel mathematical formulations of the constrained optimization problems are used that are based on the calculus of variations. Presented here are the theoretical models and methods underlying the analysis and optimization capability, comparisons with other theories, and some examples of applications. Author

N92-70499 Loughborough Univ. of Technology (England). Dept. of Transport Technology.

YACHT SAIL AERODYNAMICS. PART 1: OPTIMISING OVERALL PERFORMANCE

F. D. HALES Jul. 1989 58 p (TT-8903-PT-1; ISBN-0-904947-15-7) Copyright

The basic aerodynamic performance of yacht sails is considered. The method used is primarily due to Glauert, in his development of aerofoil and airscrew theory. Glauert's work is extended as necessary to allow for some of the peculiarities of yacht sails and their mode of operation. The original objective of the work was to enable jib and mainsail cambers to be specified so that the conic section approach to yacht sail design 2, 3, and 4 could be implemented successfully. However, the methodology has application to any sail manufacturing or development process. Perhaps more importantly it reveals a great deal about how yacht sails function and how they may be made to function better. Having developed the analytical tools for the work, the systems of equations are programmed for computer solution as part of an integrated computer aided design system for sails. Author

N92-70513 Loughborough Univ. of Technology (England).

YACHT SAIL AERODYNAMICS. PART 3: ACHIEVABLE JIBSAIL SPECIFICATION

F. D. HALES Oct. 1989 31 p (ISBN-0-904947-17-3; TT-8905) Copyright

The process to obtain an achievable jib configuration is presented. The work is needed because an achievable jib has incidence constraints with height due to the way the sail deflects under wind loading. These forces result in sail twist, to a lesser or greater degree, which act to reduce the datum sail incidence with height. Two approaches are used: simple correction to the jib camber, and complex correction that uses the constrained jib incidences to re-determine the incidence and camber of the generating compound sail and then calculates the required jib camber to smoothly fit the compound sail. Author

N92-70514 Loughborough Univ. of Technology (England). Dept. of Transport Technology.

YACHT SAIL AERODYNAMICS. PART 2: ACHIEVABLE MAINSAIL SPECIFICATION

F. D. HALES Oct. 1989 28 p (ISBN-0-904947-16-5; TT-8904) Copyright

Here, the starting point is the mainsail as delineated in Part 1. The process to obtain an achievable mainsail configuration is presented. The work is needed because an achievable mainsail has incidence constraints with height due to the way the sail deflects under wind loading. These forces result in sail twist, to a lesser or greater degree, which act to reduce the datum sail incidence with height. The matter is tackled using two approaches: simple correction to the mainsail camber, and complex correction that uses the constrained mainsail incidences to re-determine the incidence and camber of the generating compound sail and then calculates the required camber to match the new trailing edge tangent criterion. Author

N92-70540 National Aerospace Lab., Amsterdam (Netherlands). Informatics and Aerodynamics Div.

THE 3-D EULER FLOWS AROUND MODERN AIRPLANES

J. L. KUYVENHOVEN (Fokker B.V., Schiphol-Oost, Netherlands) and J. W. BOERSTOEL 16 Oct. 1989 15 p Presented at the 8th GAMM Conference on Numerical Methods in Fluid Mechanics, Delft, Netherlands, 27-29 Sep. 1989 Previously announced in IAA as A91-34201

(PB92-138759; NLR-TP-89343-U) Avail: CASI HC A03/MF A01

The numerical simulation of flows around complex aircraft configurations like the Fokker 50 and Fokker 100, is described. In these simulations, multiblock grids and a 3-D Euler-flow solver are used. The major features of the grid-generation procedure and flow solver are outlined. Results of the validation of the numerical flow-simulation system for aerodynamic design work are presented. Author

N92-70576 National Aerospace Lab., Amsterdam (Netherlands).
Fluid Dynamics Div.

SYSTEM FOR TRANSONIC WING DESIGN WITH GEOMETRIC CONSTRAINTS BASED ON AN INVERSE METHOD

F. J. BRANDSMA and J. M. J. FRAY 19 May 1989 15 p
Presented at the AGARD Specialists' Meeting on Computational Methods for Aerodynamic Design (Inverse) and Optimization, Loen, Norway, 22-23 May 1989 Previously announced as N90-20983 (PB92-138692; NLR-TP-89179-U) Avail: CASI HC A03/MF A01

A computational method is presented for the design of wings with given pressure in transonic flow, in the presence of a fixed body. The method is an inverse method of the residual correction type, combining a 'complex' direct flow solver with 'simple' correction rules. The correction rules make use of simple linear thin wing relations for the subsonic corrections and of a 3-D interpretation of the wavy wall formula for the supersonic corrections. In order to avoid problems with possible nonoptimized configurations, and to fulfill requirements from the structural engineer's point of view, geometric constraints can be taken into account. Weights on these constraints can be adjusted during the iteration process, allowing a flexible control. The practical applicability of the method is demonstrated by an example.

Author

N92-70577 National Aerospace Lab., Amsterdam (Netherlands).
Fluid Dynamics Div.

ASPECTS OF THE APPLICATION OF A EULER-EQUATION METHOD TO THE SIMULATION OF LEADING-EDGE VORTEX FLOW

J. M. J. W. JACOBS and H. W. M. HOEIJMAKERS 11 Aug. 1989 17 p Presented at the 8th GAMM Conference on Numerical Methods in Fluid Mechanics, Delft, Netherlands, 27-29 Sep. 1989 Previously announced in IAA as A91-34196 (Contract NIVR-07701N)

(PB92-138718; NLR-TP-89272-U) Avail: CASI HC A03/MF A01
The flow about a 65 deg sharp edged cropped delta wing is simulated by solving the Euler equations. Solutions are obtained for transonic vortex flow with and without shocks including cases with strong vortices. An assessment is made of the capability of the Euler method to simulate the details of the flow field, especially with respect to the influence of artificial dissipation and the influence of the computational grid.

Author

N92-70590 National Aerospace Lab., Amsterdam (Netherlands).
Fluid Dynamics Div.

INVESTIGATION OF THE LOW SPEED FLOW ABOUT A STRAKED DELTA WING OSCILLATING IN PITCH. PART 1: WINDTUNNEL, MODEL, AND TEST PROGRAM

R. G. DENBOER (General Dynamics Corp., Fort Worth, TX.) and A. M. CUNNINGHAM, JR. (General Dynamics Corp., Fort Worth, TX.) 5 Jan. 1989 39 p Submitted for publication (Contract F33615-85-C-3013) (PB92-138676; NLR-TP-89150-U-PT-1) Avail: CASI HC A03/MF A01

A low speed wind tunnel test on a straked delta wing, oscillating in pitch, was conducted in the summer of 1986 in a cooperative program between General Dynamics and the NLR. Measurements of unsteady overall airloads and pressure distributions were performed covering a wide range of incidences (-8 to 50 deg) and amplitudes (1 to 16 deg). Most test cases were carried out at a windspeed of 80 m/s. The zeroth and first harmonic of the pressures and overall loads were measured. Also time recordings were made and stored for later study of higher harmonics, power spectra and cross correlation functions. At 30 m/s visualization of the unsteady flow was performed, using a smoke tube fixed to the model and a pulsating laser light sheet. A limited number of runs with maneuver-like inputs was carried out. At these runs, only time recordings of the balance were made. Part 1 presents the test setup and the procedures used in the test. Also some examples of the results are shown.

Author

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A92-13700

MIND THAT RESTYLE

Aerospace (UK) (ISSN 0305-0831), vol. 18, Nov. 1991, p. 15-17. Copyright

An analysis of the two sequential structural failures that occurred to the same composite rudder of a Concorde aircraft is described. In addition to showing evidence of having sustained overload in failing, the adhesive surfaces showed signs that the bonding failures, like the metal skin failures, had progressed from the aft end forward. Tests have shown that the use of paintstripper and the wrong adhesive applied to the composite material of the rudder were primarily responsible for the failures.

R.E.P.

A92-23172

NO END TO INCIDENTS IN AIRSPACE? III [LUFTZWISCHENFAELLE UND KEIN ENDE? III]

JOACHIM F. BENTZIEN Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 40, Dec. 1991, p. 366-385. In German. refs

Copyright

Legal aspects of incidents of unauthorized aircraft straying into foreign airspace are discussed. Investigations by the foreign state, the punishment of pilots, and the confiscation of cargo are discussed. Diplomatic reactions in a number of individual incidents are reviewed.

C.D.

A92-23302

INDUSTRIAL MEASUREMENT OF MICROPHYSICAL PARAMETERS - APPLICATION TO NATURAL AND SIMULATED ICING CLOUDS [MESURE INDUSTRIELLE DES PARAMETRES MICROPHYSIQUES - APPLICATION AUX NUAGES GIVRANTS NATURELS ET SIMULES]

J.-F. GAYET (Clermont-Ferrand II, Universite, France), G. BOMMELAER (Centre d'Essais des Propulseurs, Saclay, France), and F. RETIF (Aerospatiale, Direction des Essais en Vol, Toulouse, France) L'Onde Electrique (ISSN 0030-2430), vol. 72, Jan.-Feb. 1992, p. 21-25. In French. refs

Copyright

Instrumentation necessary for the measurement of microphysical parameters during icing tests performed in natural or in simulated cloudes produced in wet wind tunnels is considered. The parameters which govern the icing intensity are the liquid water content and the droplet diameter. The microphysical probes used for the icing tests are described, and the accuracy obtained for the microphysical parameters is discussed. Attention is given to microphysical measurements performed during the ATR-72 aircraft icing flight tests and during the control of the simulated clouds produced in the CEPr wet wind tunnel.

L.M.

A92-25075

DAMPING DOWN THE FIRES

SIMON ELLIOTT Flight International (ISSN 0015-3710), vol. 141, Feb. 5, 1992, p. 46-49.

Copyright

A review is presented of the possible introduction of fire-retarding cabin water-spray systems into civil transport aircraft that may save lives, but with consequent penalties of increased weight, cost, and maintenance. Attention is given to various water-spray development schemes including droplet size, smoke control, flow rate, spray pattern, spray angle, and the viscosity/surface tension, temperature, and specific gravity of the liquid.

R.E.P.

03 AIR TRANSPORTATION AND SAFETY

A92-25181

A CONSTRAINT SATISFACTION APPROACH TO OPERATIVE MANAGEMENT OF AIRCRAFT ROUTING

FRANCO TORQUATI, MASSIMO PALTRINIERI, and ALBERTO MOMIGLIANO (Bull HN Information Systems Italia S.p.A., Milan, Italy) IN: IEA/AIE-90; Proceedings of the 3rd International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, Charleston, SC, July 15-18, 1990. Vol. 2. Tullahoma, TN, University of Tennessee, 1990, p. 1140-1146. refs

Copyright

This paper describes the solution to the problem of predictive and reactive aircraft routing developed in OMAR (Operative Management of Aircraft Routing). The basic philosophy is to look at aircraft routing as a constraint satisfaction problem (CSP) and to employ the most effective CSP techniques to solve it under the severe time constraints required by the customer. Author

A92-25521

THE REAL TCAS

KIERAN DALY Flight International (ISSN 0015-3710), vol. 141, Feb. 12, 1992, p. 30-32.

Copyright

An updating is provided of the TCAS traffic alert and avoidance system operational record since the system's introduction four years ago. Primary element reports indicate only a slightly blemished technical success story, qualified but broad support from aircrews, and serious questions from air traffic controllers. R.E.P.

A92-26359

AIRCRAFT ICING [LE GIVRAGE DES AERONEFS]

DIDIER GUFFOND (ONERA, Direction des Etudes de Synthese, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 148-149, 1991, p. 51-54) ONERA, TP no. 1991-202, 1991, 5 p. In French. (ONERA, TP NO. 1991-202) Copyright

A review of aircraft icing presented. Systems developed to remove ice deposits or avoid structural ice formations are described. Techniques of modeling, icing tunnel tests, and flight tests are discussed. Attention is given to computing models utilized to determine ice shapes and to predict the efficiency of antiicing or deicing systems. R.E.P.

A92-26361

AIRCRAFT LIGHTNING STRIKES [LE FOUDROIEMENT DES AVIONS]

JEAN-LOUIS BOULAY (ONERA, Division Environnement Electromagnetique, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 148-149, 1991, p. 45-50) ONERA, TP no. 1991-204, 1991, 7 p. In French. refs (ONERA, TP NO. 1991-204) Copyright

The global lightning environment for an aircraft was investigated in flight using onboard measurements obtained on the Transall 04 during several lightning events. Attention is given to the different phases of a typical lightning process. A comparison of different data obtained on several aircraft is presented, and the necessity of new simulation tests for aeronautical equipment is discussed. R.E.P.

A92-38374

AGEING AIRLINER CENSUS - STILL FLYING SAFELY

IAN GOOLD Flight International (ISSN 0015-3710), vol. 141, no. 4316, April 29, 1992, p. 24-26, 30-32, 34-36.

Copyright

A review of the current status of ageing-airliner regulation is presented and the ongoing program aimed not only at fatigue, but also at corrosion, repairs, research and development, and human factors is discussed. Attention is given to the cost of ageing, analysis of service bulletins issued, current design life and fleet status, and the number and types of jet and turboprop airliners in service, by year of build. Consideration is given to the major rework to be accomplished on ten leading aircraft jet airliner designs by various age, cycle or time thresholds. R.E.P.

A92-38375

FLYING ON THIN ICE

SIMON ELLIOT and GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, no. 4316, April 29, 1992, p. 38-40. Copyright

A review is presented of several recent aircraft accidents showing that present airliner antiicing measures are inadequate. Attention is given to these inadequacies and what is being done to correct them. R.E.P.

A92-39301

SAFETY AT SEA AND IN THE AIR - TAKING STOCK TOGETHER; PROCEEDINGS OF THE CONFERENCE, LONDON, ENGLAND, NOV. 13-15, 1990

Conference sponsored by Royal Aeronautical Society, Royal Institution of Naval Architects, Nautical Institute, et al. London, Royal Aeronautical Society, 1990, 239 p. For individual items see A92-39302 to A92-39310.

(ISBN 0-903409-78-X) Copyright

Topics presented include a review of the aviation safety record, the aviation legislative and regulatory framework, civil aircraft design in relation to airworthiness, aircraft structural design, assurance of safety in the aging aircraft fleet, and the potential benefits and hazards of increased reliance on cockpit automation. Also presented are the promotion of error tolerance in complex systems in the context of ships and aircraft, learning from aircraft accidents and incidents, and the broad operational scene and its management in aviation. R.E.P.

A92-39303

CIVIL AIRCRAFT DESIGN IN RELATION TO AIRWORTHINESS

J. C. WIMPENNY (City University, London, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 6A.1-6A.12.

Copyright

This report shows that the steady improvement in civil aviation safety records is the outcome of a close working relationship between designers in the civil aviation industry, the airworthiness certifying authorities, and the operators. An introductory outline of the certification process from the viewpoint of the aircraft designer is presented. Attention is given to the overall airworthiness process, specific issues in aircraft and component design, and some historic airworthiness milestones. R.E.P.

A92-39310

LEARNING FROM AIRCRAFT ACCIDENTS AND INCIDENTS

K. P. R. SMART (Department of Transport, Air Accidents Investigation Branch, Farnborough, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 20.1-20.5.

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This report discusses the arrangements in the U.K. for the reporting and investigation of civil aircraft accidents and incidents. It focuses on the current developments in major aircraft accident investigations, studying in particular the work of the human performance and survival studies groups. The objective is to make safety recommendations to enhance survival prospects based on the understanding of the factors that led to injuries or fatalities in an accident. R.E.P.

A92-40023

BRITISH AIRWAYS AIRBUS A320 PILOTS' AUTOTHURST SURVEY

STEVE LAST and MARTIN ALDER (British Airways, PLC, London, England) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. (SAE PAPER 912225) Copyright

The Airbus A320 has an autothrust system which is unique among transport aircraft in 'not having feedback movement provided to the pilots' thrust levers. There has been some controversy in the airline world over the operational aspects of

this system. As British Airways was one of the earliest operators of the type, a survey was conducted to determine the views of line pilots as to the advantages and disadvantages of the system compared with conventional moving levers. This paper contains the results of that survey. It was concluded that the A320 design provides advantages in respect to engagement and selection of rated power settings, and that movement provides better disengagement and information on system function. BA concludes that from a Flight Operations perspective a future system should consider providing movement between the idle and climb power positions, while retaining the A320 thrust setting and engagement 'detents' technique. Author

A92-42500

WINDSCREEN DEPARTURE

Aerospace (UK) (ISSN 0305-0831), vol. 19, no. 6, June 1992, p. 8-14.

Copyright

A review is presented of a commercial aircraft incident that occurred in June 1990, involving the inflight blowout of a British Airways One-Eleven windshield as a result of its having been installed with the wrong bolts during maintenance. An analysis of the complex events leading to this human maintenance error is provided by the report of the accident review board. R.E.P.

A92-43446

THE 1991 CIERVA LECTURE - ABERDEEN AND ITS INFLUENCE ON THE EVOLUTION OF THE COMMERCIAL IFR TWIN ENGINED HELICOPTER

ALASTAIR C. GORDON Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 955, May 1992, p. 169-183.

Copyright

The supplying of offshore oil rigs in the vicinity of Aberdeen, Scotland, has prompted significant developmental challenges for commercial helicopters in virtue of the severity of the regional climate, frequent night-flight requirement, and the need for maximum fuel loads as ranges to new oil fields increased. In particular, IFR-related avionics have been critical factors in the achievement of the requisite safety levels. Attention is given to the weight growth incurred by helicopters in this service environment, as well as the management of helicopter maintenance operations and the character of training and simulation. O.C.

A92-44998

THE EFFECT ON AIRCRAFT EVACUATIONS OF PASSENGER BEHAVIOUR AND SMOKE IN THE CABIN

HELEN MUIR and CLAIRE MARRISON (Cranfield Institute of Technology, England) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 656-661. refs

In response to a request from the UK CAA, an experimental program was conducted to characterize the effects of passenger behavior on the flow rates of emergency evacuation under conditions of vision impairment by smoke. The objective of this investigation was to ascertain the optimum width of the bulkhead prior to type I exit, as well as the seating configuration adjacent to the overwing exit. The results of a comparison of video data from competitive and noncompetitive evacuations (NCEs) indicate that NCEs effectively simulated aircraft behavior in precautionary evacuations, and in evacuations in which cabin physical conditions have not deteriorated. O.C.

A92-53236

HUMAN FACTORS AND SIMULATION [LES FACTEURS HUMAINS A TRAVERS LA SIMULATION]

NOEL CHEVRIER (UTA French Airlines, Paris, France) (Institut Francais de Navigation, Colloque sur la Simulation Aerienne et Maritime, Paris, France, Dec. 11, 1991) Navigation (Paris) (ISSN 0028-1530), vol. 40, no. 159, July 1992, p. 287-303. In French. Copyright

A study of human performance factors involved in aircraft accidents is presented, focusing on cockpit human factors research

requirements is presented. It is shown that, although, aircraft design and development and cockpit automation have made great progress, human errors in aircraft accidents continue to be prevalent. Attention is given to the role played by the ICAO in accident investigation and research in accident prevention, simulator training, cockpit resource management, and line oriented flight training. R.E.P.

A92-56155

NINE-DEGREE-OF-FREEDOM SIMULATION OF ROTATING PARACHUTE SYSTEMS

KARL-FRIEDRICH DOHERR (DLR, Institut fuer Flugmechanik, Braunschweig, Germany) and HARTMUT SCHILLING (Rheinmetall GmbH, Duesseldorf, Germany) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 5, Sept.-Oct. 1992, p. 774-781. Previously cited in issue 12, p. 1908, Accession no. A91-32188. refs Copyright

N92-14007# Royal Aerospace Establishment, Farnborough (England). Aerospace Div.

LIGHTNING PROTECTION REQUIREMENTS FOR AIRCRAFT: A PROPOSED SPECIFICATION

G. A. M. ODAM, A. W. HANSON, and R. H. EVANS 16 May 1991 50 p Revised

(RAE-TM-FS(F)-632-REV-ISSUE-1; BR303122; ETN-92-90319)

Copyright Avail: CASI HC A03/MF A01

The RAE/FS8 recommendation for a specification to define United Kingdom Ministry of Defence requirements for the lightning protection of aircraft is presented. The following are covered: background and advisory material, certification, design and testing requirements. ESA

N92-20794# Cranfield Inst. of Tech., Bedford (England). Centre for Transport Studies.

AN EVALUATION OF IN-CABIN SAFETY FEATURES IN PASSENGER AIRCRAFT M.S. Thesis

D. J. NICOL Aug. 1990 209 p

(ETN-92-90656) Copyright Avail: CASI HC A10/MF A03

Aircraft passenger safety considerations are evaluated. The advantages of providing smokehoods for passengers and an onboard tender-fed water mist spray system are considered. Cabin configuration, with special reference to seat pitch and aisle width in and around emergency exits, is considered. Safety features which might improve the egress capability of passengers after a survival accident are evaluated within an economic framework. A mathematical model, to be used to determine the effect of cost and weight of various proposed safety features, is developed. ESA

N92-21679# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.

EFFECTS OF ADVERSE WEATHER ON AERODYNAMICS

Dec. 1991 287 p In ENGLISH and FRENCH Meeting held in Toulouse, France, 29 Apr. - 1 May 1991

(AGARD-CP-496; ISBN-92-835-0644-8; AD-A246297) Copyright Avail: CASI HC A13/MF A03

This meeting was organized to provide a timely review of the progress being made in advancing the state of the art in predicting, simulating, and measuring the effects of icing, anti-icing fluids, and various forms of precipitation on the aerodynamic characteristics of flight vehicles. Topics included results from both theoretical and experimental programs and material related to procedures and regulations for certification and operation. International participation for the meeting included authors from eight nations and representatives from most of the 16 NATO nations.

N92-21680# Renaudie (J. F.), Versailles (France).

FLIGHT IN ADVERSE ENVIRONMENTAL CONDITIONS

J. F. RENAUDIE In AGARD, Effects of Adverse Weather on Aerodynamics 21 p Dec. 1991

Copyright Avail: CASI HC A03/MF A03

Brief accounts are given of a number of papers presented at

03 AIR TRANSPORTATION AND SAFETY

the Flight Mechanics Panel (FMP) Symposium held in Gol, Norway May 8 to 11, 1989. Atmospheric measurements and modeling, the effect of disturbances on design and operations, visibility, aircraft icing, and electromagnetic disturbances are discussed.

Author

N92-21683# Centre d'Essais en Vol, Istres (France). Ingenieur Navigant d'Essais.

REGULATIONS AND THEIR CHANGES FOR CERTIFICATION OF CIVIL AIRCRAFT IN ICING CONDITIONS [EVOLUTION REGLEMENTAIRE EN MATIERE DE CERTIFICATION DES AVIONS CIVILS EN CONDITIONS GIVRANTES]

GILBERT CATTANEO /In AGARD, Effects of Adverse Weather on Aerodynamics 9 p Dec. 1991 In FRENCH
Copyright Avail: CASI HC A02/MF A03

Experience acquired in the process of certifying standards and service use of civil aircraft has shown that a change of regulations is necessary. The regulatory changes in maintaining a safety level during flight in icing conditions that are comparable to flight in conditions where no icing is possible are discussed. Author

N92-21689# Royal Aerospace Establishment, Farnborough (England).

A REVIEW OF ICING RESEARCH AT THE ROYAL AEROSPACE ESTABLISHMENT

R. W. GENT /In AGARD, Effects of Adverse Weather on Aerodynamics 15 p Dec. 1991
Copyright Avail: CASI HC A03/MF A03

A brief review of the computer models developed by the Royal Aerospace Establishment (RAE) for the analysis of natural rotor icing and rotor protection against icing is provided. Experimental results are then presented for the increase in profile drag due to rime, glaze, and beak type icing. These data, combined with other published data, were used to obtain correlations for iced profile performance which were included in a computer model of helicopter performance. This enables the prediction of the increase in rotor power required by a helicopter with unprotected rotors during flight in icing conditions. Comparisons between model prediction and both rig and flight test data are given. K.S.

N92-21692# Fokker B.V., Schiphol-Oost (Netherlands). Aerodynamics and Aeroelasticity Dept.

THE EFFECT OF HOAR-FROSTED WINGS ON THE FOKKER 50 TAKE-OFF CHARACTERISTICS

J. VANHENGST and J. N. BOER /In AGARD, Effects of Adverse Weather on Aerodynamics 9 p Dec. 1991
Copyright Avail: CASI HC A02/MF A03

Reviewed here is how contamination resulting from ice, snow, or frost accumulated during ground icing degrades the Fokker 50 aircraft aerodynamics and leads to reduced flight safety during takeoff. From simulation tests it was concluded that wing contamination due to ground frost seriously deteriorates the aircraft behavior in takeoff, leading to reduced flight safety. A large increase in takeoff distance is experienced. No improvement was found from cleaning the wing leading edge only or by increasing rotation speed. The results clearly demonstrate the importance of Advisory Circular AC 20-117 emphasizing the 'clean aircraft concept' under adverse weather conditions before takeoff. Author

N92-21693# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).

PREPARATION OF THE ICE CERTIFICATION OF THE DORNIER 328 REGIONAL AIRLINER BY NUMERICAL SIMULATION AND BY GROUND TEST

D. WELTE (Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.)), W. WOHLRATH (Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.)), R. SEUBERT (Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.)), W. DIBARTOLOMEO (Pratt and Whitney Aircraft of Canada Ltd., Longueuil (Quebec)), and R. D. TOOGOOD (Pratt and Whitney Aircraft of Canada Ltd., Longueuil, Quebec) /In AGARD, Effects of Adverse Weather on Aerodynamics 14 p Dec. 1991
Copyright Avail: CASI HC A03/MF A03

The Dornier 328, a new regional airliner, is to be qualified to FAR25/JAR25 requirements for operation into known icing conditions. All lifting surfaces are pneumatically deiced. Impingement limits were determined using a validated computational fluid dynamic (CFD) code. Wind tunnel tests with a model of the whole aircraft and the isolated empennage equipped with artificial ice shapes showed a degradation of handling characteristics due to ice accretion. Extensive two and three dimensional CFD calculations evaluated ice accretion at the deflection elevator horn. Icing tunnel tests were performed with a model of the horizontal tail with icing similitude fulfilled. The Dornier Do328 powerplant air induction system has successfully completed a program of icing tests in support of aircraft certification for operation into known icing conditions. Potential flight icing conditions were extensively analyzed using a CFD potential flow code and 3-D particle tracking routine to identify critical flight icing conditions. The tunnel test program verified the analytically predicted critical ice accretion surfaces of the air induction system, the adequacy of the ice protection provisions and demonstrated compliance with the applicable (JAR25) regulatory material.

Author

N92-21697# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). Aeronautics/Aerospace Dept.
AERODYNAMIC EFFECTS OF DE/ANTI-ICING FLUIDS AND DESCRIPTION OF A FACILITY AND TEST TECHNIQUE FOR THEIR ASSESSMENT

MARIO CARBONARO /In AGARD, Effects of Adverse Weather on Aerodynamics 20 p Dec. 1991
Copyright Avail: CASI HC A03/MF A03

Research carried out at the von Karman Institute, from 1984 to the present, on the subject of flow-off of aircraft de-icing and anti-icing fluids is presented. Additionally, a test methodology for the acceptance of anti- and de-icing fluids is described. D.R.D.

N92-21746 Civil Aviation Authority, London (England).

UK AIRMISSES INVOLVING COMMERCIAL AIR TRANSPORT: SEPTEMBER - DECEMBER 1990

Jul. 1991 44 p
(ISSN 0951-6301)

(ETN-92-91050) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England

United Kingdom (UK) airmisses are reported. The origin of an airmis, the purpose and investigation of airmis reports, the categories of airmisses, the involvement of commercial air transport traffic, and airmisses related to flying hours are discussed. Airmis reports for Sep. to Dec. 1990 are given. Statistics in commercial transport airmisses are presented. ESA

N92-21873# National Transportation Safety Board, Washington, DC.

AIRCRAFT ACCIDENT REPORT: UNSTABILIZED APPROACH AND LOSS OF CONTROL NPA, INC. DBA UNITED EXPRESS FLIGHT 2415, BRITISH AEROSPACE BA-3101, N410UE, TRI-CITIES AIRPORT, PASCO, WASHINGTON, DECEMBER 26, 1989

4 Nov. 1991 68 p
(PB91-910406; NTSB/AAR-91/06) Avail: CASI HC A04/MF A01; paper copy available on Standing Order, deposit account required (minimum deposit \$100 U.S., Canada, and Mexico; all others \$200)

On December 26, 1989, United Express, Flight 2415 (Sundance 415), a British Aerospace BA-3101 Jetstream, N410UE, crashed approximately 400 feet short of runway 21R at Tri-Cities Airport, Pasco, Washington. The airplane crashed while executing an instrument landing approach to the runway. The airplane was destroyed and the two pilots and all four passengers received fatal injuries. Author

N92-26349# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

THE ICING OF THE WING UPPER SIDE AND BOTTOM SIDE OF THE ICING RESEARCH AIRCRAFT OF THE DLR [DIE VEREISUNG DER TRAGFLAECHE OBERSEITE UND -UNTERSEITE DES VEREISUNGSFORSCHUNGSFLUGZEUGS DER DLR]

HANS-EBERHARD HOFFMANN and JOHANN DEMMEL *In its Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday* p 215-222 Sep. 1991 In GERMAN; ENGLISH summary
Berichtswesen, Postfach 90 60 58, Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

It is shown by photographs, that when the wing bottom side is strongly iced, the upper side also attains large values: extension 40 cm, roughness 6 mm. This occurred when the total water was between 0.05 and 0.13 g/m(exp 3), the temperature between -2.1 and 3.4 C, and the median volume diameter between 115 and 236 micrometers. ESA

N92-28655# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

APPLICATION OF KNOWLEDGE-BASED SYSTEMS FOR DIAGNOSIS OF AIRCRAFT SYSTEMS [TOEPASSING VAN KENNISSYSTEMEN VOOR DIAGNOSE VAN Vlieguitgystemen]

J. C. DONKER and M. A. PIERS 28 Apr. 1990 22 p In DUTCH Presented at the AI Applications Conference, Kerkrade, Netherlands, 10-15 Jun. 1991
(Contract NIVR-01708-N)

(NLR-TP-90192-U; ETN-92-91439) Avail: CASI HC A03/MF A01

The applicability of knowledge based systems for the monitoring and diagnosis of aircraft systems was investigated in order to provide tools with which maintenance can be performed more effectively and efficiently. A knowledge based system was designed to support ground engineers in the maintenance of the Fokker 100 air conditioning system. The evaluation shows that the system performs well if complaints are described with enough detail. The main conclusion is that design and experience knowledge needed to support the maintenance personnel can be collected and implemented in a usable system. ESA

N92-29703# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

ON THE OPTIMIZATION OF WINDSHEAR WARNING AND GUIDANCE SYSTEMS

J. L. SOESMAN 25 Jun. 1990 31 p Presented at the 17th ICAS Congress Student Session, Stockholm, Sweden, 9-14 Sep. 1990

(NLR-TP-90196-U; ETN-92-91440) Avail: CASI HC A03/MF A01

The results of a survey of several investigations into windshear detection, guidance and modeling is presented. The use of the results to improve future windshear warning and guidance systems and wind models for simulation, to obtain safer operation in windshear conditions, is shown. Some natural causes and simple models of windshear are presented and a theoretical analysis on the effect of windshear on performance and flight safety is made. Optimally guided flight trajectories through windshear that are computed in open loop form, using a point mass model, are compared with simulated closed loop suboptimal trajectories. The effect on survivability of different initial conditions and early warnings by forward looking detection systems are discussed. Experiences with an operational reactive windshear warning system aboard aircraft are reported. Natural causes of the shear, pilot's reactions and their result on the flight safety level are discussed. ESA

N92-30123*# Airbus Industrie, Blagnac (France).

AGEING AIRPLANE REPAIR ASSESSMENT PROGRAM FOR AIRBUS A300

J. M. GAILLARDON, HANS-J. SCHMIDT, and B. BRANDECKER *In NASA. Langley Research Center, The 1991 International*

Conference on Aging Aircraft and Structural Airworthiness p 283-289 Jul. 1992

Avail: CASI HC A02/MF A04

This paper describes the current status of the repair categorization activities and includes all details about the methodologies developed for determination of the inspection program for the skin on pressurized fuselages. For inspection threshold determination two methods are defined based on fatigue life approach, a simplified and detailed method. The detailed method considers 15 different parameters to assess the influences of material, geometry, size location, aircraft usage, and workmanship on the fatigue life of the repair and the original structure. For definition of the inspection intervals a general method is developed which applies to all concerned repairs. For this the initial flaw concept is used by considering 6 parameters and the detectable flaw sizes depending on proposed nondestructive inspection methods. An alternative method is provided for small repairs allowing visual inspection with shorter intervals. Author

N92-30129*#

National Aerospace Lab., Emmeloord (Netherlands).

AGEING AIRCRAFT RESEARCH IN THE NETHERLANDS

J. B. DEJONGE and G. BARTELDIS *In NASA. Langley Research Center, The 1991 International Conference on Aging Aircraft and Structural Airworthiness* p 327-335 Jul. 1992 Sponsored in part by FAA and Dept. of Civil Aviation

Avail: CASI HC A02/MF A04

The problems of aging aircraft are worldwide. Hence, international cooperative actions to overcome or prevent problems should be taken. The Federal Aviation Administration (FAA) and the Netherlands Civil Aviation Department (RLD) signed a Memorandum of Cooperation in the area of structural integrity, with specific reference to research on problems in the area of aging aircraft. Here, an overview is given of aging research that is going on in the Netherlands. The work described is done largely at the National Aerospace Laboratory; much of the research is part of the forementioned cooperative agreement. Author

N92-30130*# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

SURVEY OF FRENCH ACTIVITIES CONCERNING STRUCTURAL AIRWORTHINESS AND AGING AIRCRAFT

ROGER LABOURDETTE *In NASA. Langley Research Center, The 1991 International Conference on Aging Aircraft and Structural Airworthiness* p 337-360 Jul. 1992

Avail: CASI HC A03/MF A04

French activities concerning structural airworthiness and aging aircraft are presented. Basic applied research, full-scale testing, teardown inspections, crack initiation, fatigue crack growth, fretting fatigue, non-destructive inspection, and damage tolerance are among the topics covered. Author

N92-30133*# Saab-Scania, Linkoping (Sweden). Aircraft Div.
A MANUFACTURER'S APPROACH TO ENSURE LONG TERM STRUCTURAL INTEGRITY

HANS ANSELL, BILLY FREDRIKSSON, and INGVAR HOLM *In NASA. Langley Research Center, The 1991 International Conference on Aging Aircraft and Structural Airworthiness* p 379-405 Jul. 1992

Avail: CASI HC A03/MF A04

The main features of the design concepts for the Saab 340 and Saab 2000 aircraft are described with respect to structural integrity and high reliability. Also described is the approach taken at Saab Aircraft to ensure structural integrity and high reliability. The concepts of global and local loads and sequences, and the fatigue and damage tolerance sizing and their verification are discussed. Also described is quality assurance in the production and structural maintenance program. Structural repair and feedback from operators are also covered. Author

03 AIR TRANSPORTATION AND SAFETY

N92-30418# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

THE EUROFAR PROGRAM: AN EUROPEAN OVERVIEW ON ADVANCED VTOL CIVIL TRANSPORTATION SYSTEM

J. RENAUD (Aerospatiale, Paris, France), H. HUBER, and G. VENN (Westland Helicopters Ltd., Yeovil, England) 1991 12 p Presented at the 17th European Rotorcraft Forum, Berlin, Fed. Republic of Germany, 24-27 Sep. 1991 (MBB-UD-0611-91-PUB; ETN-92-91890) Avail: CASI HC A03/MF A01

Some European overviews on the role which could be devoted to a Vertical Take Off and Landing (VTOL) transportation system based on the tilt rotor, and the conditions of introduction of this aircraft within civil community, are summarized. As regards these issues, the Eurofar approach is based on aircraft design activities, and on studies related to marketing, infrastructure and airspace system. ESA

N92-30474# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

EXAMINATION OF AIRCRAFT WARNING AND CAUTION LIGHTS AFTER SHOCK TESTING

W. J. A. BONNEE and H. J. KOLKMAN 15 Aug. 1989 16 p Presented at the International Symposium for Testing and Failure Analysis, Los Angeles, CA, 6-10 Nov. 1989 Sponsored by Royal Netherlands Air Force (NLR-TP-89284-U; ETN-92-91525) Avail: CASI HC A03/MF A01

Warning and caution light bulbs recovered after aircraft accidents provide useful information. It is generally assumed that upon impact the filament of an unlit bulb will break without deformation, whereas a hot filament will show extensive elongation. Deviations from this idealized behavior were investigated by shock tests on F-16 warning and caution light bulbs. From the tests it could be concluded that relatively new lamps do not show the idealized behavior described above. This makes it necessary in certain cases to estimate the number of burning hours by a simple scanning electron microscopy (SEM) investigation of the surface morphology of the filament. Besides its age, the behavior of a filament upon impact is also influenced by the direction and especially the duration and maximum g-level of the impact. However, the behavior of a burning lamp is not influenced by deviations from the correct voltage. The above results are included in a recommended procedure for examining light bulbs after aircraft accidents. ESA

N92-31813# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abteilung Wolkenphysik.

THE ICING OF THE ELEVATOR OF THE DLR ICING RESEARCH AIRCRAFT OF DO 28 TYPE [DIE VEREISUNG DES HOEHENRUEDERS DES VEREISUNGSFORSCHUNGSFLUGZEUGS DER DLR VOM TYP DO 28]

HANS-EBERHARD HOFFMANN, JOHANN DEMMEL, and JOACHIM SCHUSTER Aug. 1991 67 p In GEORGIAN (DLR-MITT-91-12; ISSN-0939-298X; ETN-92-91732) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

Observations of the icing of the elevator for information on the type of accretion are addressed. Most of the coarse ice structures observed until now could be related to the following icing classes: 1st stripe of rime ice; 52 stripes of rime ice as borders of one stripe of clear ice; 3 stripes of rime ice with and without clear ice between them; and 3 stripes of rime ice growing together. The maximum extension of ice accretion on the upper and bottom side of the elevator amounted to 80 mm. In this case, the temperature was about -2.5 C, the median volume diameter of the cloud particles about 400 micrometers, and the total water content between 0.02 and 0.10 g/cu m. The roughness had its maximum value of 19 mm after an incomplete pneumatic deicing. Without influence of pneumatic deicing the maximum roughness was 15 mm. ESA

N92-31943# European Space Agency, Paris (France).

ANALYSIS OF THREE ICING TEST FLIGHTS REACHING THE AIRCRAFT-REFERRED ICING DEGREE OF SEVERE

HANS-EBERHARD HOFFMANN (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) and JOHANN DEMMEL (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Mar. 1992 107 p Transl. into ENGLISH of Eine Analyse von drei Vereisungsfluegen mit Erreichen des Luftfahrzeugbezogenen Vereisungsgrades Severe (Oberpfaffenhofen, Germany, DLR), Aug. 1990 118 p Original language document was announced as N91-21123

(ESA-TT-1254; DLR-FB-90-34; ETN-92-91711) Avail: CASI HC A06/MF A02

Three test flights in icing conditions are discussed: one in the range of a high pressure area, and the other two in the range of warm fronts, where the aircraft-referred icing degree of 'severe' was reached. The ice accretion on the underside of the wing of the Do28 extended (at 50 to 70 cm) beyond the area which can be pneumatically deiced. In the area of the pneumatic deicing boots, the deicing was totally ineffective or incomplete. The mean values of the cloud physics parameters which produced the aircraft referred icing degree of 'severe' were: total water content 0.20, 0.22, 0.30 g/cu m; temperature -1.8, -2.0, -4.5 C; and median volume diameter 20, 180, and 300 microns. The cloud flight paths in the range of the warm fronts were only 1/10 to 3/10 of the cloud flight path in the range of high pressure areas when it came to attaining the maximum icing characteristics achieved in the range of a high pressure area. The reason for this was the considerably higher value of the median volume diameter in the range of the warm fronts. ESA

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A92-11877

THE EUROPEAN ATC CHALLENGE

MICHEL JUBE (Thomson-CSF, Paris, France) ICAO Journal (ISSN 0018-8778), vol. 46, Sept. 1991, p. 20-22.

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The causes of the air traffic control (ATC) problems of Europe are discussed, which include, in some cases, congestion due to the lack of homogeneous radar coverage and, in other cases, an over-interrogation of aircraft due to the presence of too many secondary radars. A four-phase mode S radar development program which was initiated in 1984 in order to supply homogeneous radar coverage of Europe's airspace is described, along with a new-generation communications system for improved control and communications, which features a fully decentralized architecture and full ADA software. I.S.

A92-13851

THE AERONAUTICAL MOBILE SATELLITE SERVICE (AMSS). I - ARCHITECTURE OF THE AMSS SYSTEM [LE SERVICE MOBILE AERONAUTIQUE PAR SATELLITES /AMSS/. I - L'ARCHITECTURE DU SYSTEME AMSS]

FRANCIS BRANGIER (Direction Generale de l'Aviation Civile, Centre d'Etudes de la Navigation Aerienne, Orly, France) Navigation (Paris) (ISSN 0028-1530), vol. 39, Oct. 1991, p. 479-489. In French. refs

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The principal technical features of the ICAO AMSS architecture as currently defined are presented. Attention is given to the satellites comprising the AMSS, the airborne instrumentation, the ground-based instruments, and the regional communication coordination control centers. Consideration is also given to the

specific communication channels to be utilized, present limitations of the system and the means provided for future expansion.

R.E.P.

A92-13852

THE AERONAUTICAL MOBILE SATELLITE SERVICE (AMSS). II - FREQUENCY SPECTRUM REQUIREMENTS FOR THE AERONAUTICAL MOBILE SATELLITE SERVICE [LE SERVICE MOBILE AERONAUTIQUE PAR SATELLITES /AMSS/. II - LE BESOIN EN SPECTRE DE FREQUENCES POUR LE SERVICE MOBILE AERONAUTIQUE PAR SATELLITES]

OLIVIER CAREL (Direction Generale de l'Aviation Civile, Direction de la Navigation Aerienne, Paris, France) Navigation (Paris) (ISSN 0028-1530), vol. 39, Oct. 1991, p. 489-495. In French.

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An overview is presented of the necessity for an expanded frequency spectrum to satisfy the requirements of the AMSS. Several frequencies have already been removed from the aviation sector to be authorized instead for ground mobile operators. The proposals submitted by ICAO for consideration by the International Telecommunication Union controlling body include a spread of frequencies reserved exclusively for commercial aviation to insure safety of operations at all times.

R.E.P.

A92-16934

AIRCRAFT NAVIGATION USING GLOBAL POSITIONING SYSTEM IMPROVED WITH GEOSTATIONARY SATELLITES

L. CAPORICCI, S. DI GIROLAMO (Ital Spazio S.p.A., Rome, Italy), and F. GRAZIANI (Roma I, Universita, Rome, Italy) IN: ION GPS-90; Proceedings of the 3rd International Technical Meeting of the Satellite Division of the Institute of Navigation, Colorado Springs, CO, Sept. 19-21, 1990. Washington, DC, Institute of Navigation, 1990, p. 217-224. refs

A study analyzing the real performances obtainable in the Mediterranean area by utilizing the basic GPS/NAVSTAR constellation is presented. The additional elements capable of enhancing the overall performances are also outlined. The integrated solutions considered are based on the utilization of geostationary satellites. With this approach it is possible to provide a navigation service resulting in adequate safety standards relevant to the projected traffic volume of future years.

R.E.P.

A92-16969

RESULTS OF A TEST PROGRAM FOR THE USE OF DIFFERENTIAL GPS FOR APPROACH GUIDANCE

NICO VAN DRIEL and ROBERT KRIJN (National Aerospace Laboratory, Amsterdam, Netherlands) IN: ION GPS-90; Proceedings of the 3rd International Technical Meeting of the Satellite Division of the Institute of Navigation, Colorado Springs, CO, Sept. 19-21, 1990. Washington, DC, Institute of Navigation, 1990, p. 621-629. refs

A test program of a GPS receiver is described to assess the use of differential P-code GPS for precision aircraft approaches. A research aircraft is equipped with the receiver, and a second receiver is employed in the surveyed position to broadcast differential GPS corrections. The processed data on board the aircraft provide localizer and glide-slope deviation signals and displayed on a programmable electronic flight system. Examination of the results indicates that the system is accurate to within decimeters and gives a 3D postflight aircraft trajectory. At the runway threshold the mean horizontal position error is 1.7 m, and the RMS error is 5.3 m. The mean altitude error and corresponding RMS error are -10.3 m and 7.0 m respectively. The system based on differential GPS is concluded to provide an aircraft trajectory efficiently but with some error due to resolution.

C.C.S.

A92-23297

TRANSITION TO COOPERATIVE ATM SYSTEM REQUIRES COMMITMENT

G. A. PAULSON (Civil Aviation Authority, National Air Traffic Services, London, England) ICAO Journal (ISSN 0018-8778), vol. 46, Dec. 1991, p. 10-13.

Copyright

The incompatibility of existing European ATC systems is emphasized to argue the necessity for an improved air-traffic management (ATM) system and the conditions for successful implementation. An enhanced system for several countries suggests the existence of compatible engineering systems and interfaces, standardized operating procedures, and political commitment to integration of ATC systems into one ATM scheme. A strategy for the implementation phase is described called the Enhanced ATM and Mode-S Implementation in Europe which exploits air-ground digital-data-interchange technology to provide a closely coupled air-ground environment.

C.C.S.

A92-24943

QUANTITATIVE ESTIMATION OF SECONDARY SURVEILLANCE RADAR INFORMATION

D. J. A. WEEDA, L. P. LIGTHART, L. R. NIEUWKERK (Delft University of Technology, Netherlands), and D. C. M. VAN DER KLEIN (Department of Civil Aviation, The Hague, Netherlands) Journal of Navigation (ISSN 0373-4633), vol. 45, Jan. 1992, p. 26-35.

Copyright

Improved radar surveillance for air traffic control can be obtained by the integration of radar systems. Integration, however, might cause the delay of radar information, which would hamper the air traffic controllers in their work. To estimate the delay, a mathematical equation to assess the amount of radar information causing this delay has been deduced from the properties of the behavior of air traffic. The mathematical equation has been tested using results obtained from operational secondary surveillance radar in the Netherlands.

Author

A92-24945

THE AVOIDANCE OF COLLISIONS FOR NEWTONIAN BODIES WITH HIDDEN VARIABLES

B. D. BRAMSON (Royal Signals and Radar Establishment, Malvern, England) Journal of Navigation (ISSN 0373-4633), vol. 45, Jan. 1992, p. 52-59. refs

Copyright

The collision avoidance of a pair of uniformly moving bodies is considered in three dimensions. The relative motion of the bodies yields an expression relating the time to closest approach, the minimum range, the current range and its rate of change, other variables being unobservable. A Boolean relation is then proposed that is satisfied whenever the minimum range and time to closest approach simultaneously fall below given thresholds. The relation is further studied, in particular with regard to the issue of false and premature alarms. An airborne collision avoidance system is a possible application.

Author

A92-24946

EUROPEAN STUDIES TO INVESTIGATE THE FEASIBILITY OF USING 1000 FT VERTICAL SEPARATION MINIMA ABOVE FL 290. II - PRECISION RADAR DATA ANALYSIS AND COLLISION RISK ASSESSMENT

D. HARRISON (Civil Aviation Authority, London, England) and G. MOEK (National Aerospace Laboratory, Amsterdam, Netherlands) Journal of Navigation (ISSN 0373-4633), vol. 45, Jan. 1992, p. 91-106. refs

Copyright

This paper is the second of a series of three papers, documenting the European studies into the feasibility of 1000 ft vertical separation minima above FL 290. The paper discusses the vertical collision risk, estimation methodology, and an assessment of the collision risk against a target level of safety. The analysis indicates the technical feasibility of a reduced vertical separation minima in the North Atlantic Region. However, for current operations and technical performance within European continental airspace, the risk estimation indicates that a 1000 ft minima is not technically feasible.

Author

A92-25520

BEHIND THE SCREENS

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

JULIAN MOXON Flight International (ISSN 0015-3710), vol. 141, Feb. 12, 1992, p. 26-29.

Copyright

An overview is presented of the current status and continuing development of the Central Flow Management Unit (CFMU) to manage the harmonizing and integration of Europe's ATC and to push the development of an advanced system to replace that in operation today. The initial move towards the CFMU involved rationalizing the existing flow-management units, which meant reducing the 12 ATC centers to five. Attention is given to the three phases of CFMU activity: strategic, pretactical and tactical, the latter stage functioning as closely as possible to the moment of an aircraft's departure, at which time it becomes the responsibility of ATC. Strategic planning covers all activities up to six months prior to an aircraft's departure. R.E.P.

A92-25655

ARINC AND COMMERCIAL AIRCRAFT AVIONICS. I [ARINC Y LA AVIONICA DE LOS AVIONES COMERCIALES. I]

J. C. MEIZOSO Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 326, 1992, p. 21-26. In Spanish.

Copyright

Aeronautical Radio, Inc. (ARINC) was founded in 1929 in order to furnish aircraft radio communications; it encompasses four coordination and development activities committees respectively concerned with: (1) Airlines Electronic Engineering; (2) Avionics Maintenance; (3) Aeronautical Frequencies, and (4) Aviation Coordinating for Telecommunications Services. Attention is presently given to the rationale for, and implementation of, ARINC's Integrated Modular Avionics System, with the requisite clarifications concerning the concepts of applications software, fail-critical functions, system integrity, reconfiguration, and failure resistance/tolerance. O.C.

A92-33427

A EUROPEAN PERSPECTIVE ON THE CO-OPERATIVE AIR TRAFFIC MANAGEMENT CONCEPT

GEORGE A. PAULSON (Civil Aviation Authority, London, England) IN: Radio Technical Commission for Aeronautics, Technical Symposium, Washington, DC, Nov. 18-20, 1991, Proceedings. Washington, DC, Radio Technical Commission for Aeronautics, 1991, p. 37-47.

Copyright

European initiatives in creating the cooperative air traffic management system are addressed focusing on the key program for progressive integration of the various states' air traffic control systems and the Eurocontrol program for enhanced air traffic management and mode S implementation in Europe. The future cooperative air traffic management system in Europe is being realized in three major areas: integration of disparate ATC systems under the 10-billion ECU harmonization and integration program; exploitation of the air-ground digital data interchange technology to provide a more cooperative and closer-coupled air-ground controller-pilot air traffic management environment; and strengthening the traditional cooperation between ATS providers and industry, and increasing the industry's role in the concept development project definition and systems operation. O.G.

A92-33438

THE VIEW FROM THE AIRPORT

PHILIPPE ROCHAT (Geneva Airport Authority, Switzerland) IN: Future air traffic control and navigation systems; Proceedings of the AIAA International Civil Aviation Seminar, Paris, France, June 12, 1991. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 35-38.

Copyright

An overview of how airport operations can benefit from the capabilities offered by the Future Air Navigation System (FANS) worldwide is presented. From the airport perspective, the following elements of the FANS concept of particular importance include: improved navigation enroute and particularly in terminal areas using GLONASS, achievement of airport surface navigation, surveillance guidance and control systems, and development of satellite

communication and other Automatic Dependant Surveillance techniques for terminal areas. FANS will probably contribute much more than other means to the universal implementation of air navigation plans and international standards for the regularity, safety, and efficiency of civil air transport. R.E.P.

A92-35928

APPROACH FLIGHT TRIALS IN THE NETHERLANDS FOR THE NAVSTAR GPS JOINT PROGRAM OFFICE INTERNATIONAL TEST PROGRAM

ROBERT KRIJN and NICO VAN DRIEL (National Aerospace Laboratory, Amsterdam, Netherlands) IN: Society of Flight Test Engineers, Annual Symposium, 21st, Garden Grove, CA, Aug. 6-10, 1990, Proceedings. Lancaster, CA, Society of Flight Test Engineers, 1990, p. 1.2-1 to 1.2-11. refs

Copyright

A differential P-code GPS is tested to evaluate its use in determining precision aircraft approaches with emphasis placed on available position accuracy. Two GPS high-dynamics 3A receivers are employed with one on the research aircraft and one located at a surveyed position to transmit differential GPS corrections. ILS-like localizer and glide-slope deviation signals are generated by means of processing the GPS data with the differential corrections on the aircraft. The system is tested for different runway/approach configurations by having an evaluation pilot analyze the GPS signals on the primary flight display of the electronic flight-instrument system. The differential P-code GPS is shown to give mean altitude and horizontal-position errors of -10.2 and 1.7 m respectively, and the system is found to be comparable to the ILS system. The lateral-guidance information is shown to be accurate and stable, although glide-slope tracking is considered more difficult with the present system. C.C.S.

A92-37072

ARINC AND THE AVIONICS OF COMMERCIAL AIRCRAFT. II [ARINC Y LA AVIONICA DE LOS AVIONES COMERCIALES. II]

J. C. MEIZOSO Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 11-17. In Spanish.

Copyright

The development of specifications for avionics systems is discussed with specific attention given to the classification of three centralized modular IMA systems. The system architecture for the IMA comprises modular components that distribute the resources for processing, memory, and interface. A schematic description of the IMA system is given with particular attention given to the feed and feed-distribution buses and the required software. The IMA bus is described in terms of its role as the connection for the avionics system of sensors, actuators, and indicators, and the certification of the systems is described. The certification methodology focuses on the possibility of multiple failures, generic errors, and the damaging effects of EMI interference. It is suggested that the IMA systems based on the ARINC specifications can be developed as modular systems with a high degree of integration and good fault-resistance. C.C.S.

A92-37073

IBERIA'S AERONAUTICAL MAPPING APPLICATION (ACAI) [APLICACION DE CARTOGRAFIA AERONAUTICA DE IBERIA /ACAI/]

ANTONIO C. PROVENCIO, LORENZO DEL CASTILLO CABRERIZO, IGNACIO G. TABUYO, and EUGENIO O. MONTERO (Iberia Lineas Aereas de Espana, Madrid, Spain) Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 26-32. In Spanish.

Copyright

A system of computer programs for generating aeronautical maps developed in Spain called ACAI is presented and described in terms of its design and capabilities. The ACAI utilizes six graphics stations, an Intergraph-250 central unit, and a laser plotter, and the system can generate radio-facility charts, maps of airports with departures and arrivals, and instrument approach and landing maps. The ACAI contains databases of geography, the structure of relevant airspace, and aeronautical infrastructure. The general

procedures for loading data, retrieving maps, and editing map documents are set forth with attention given to the inclusion of specific information types and to map-product quality. The present version of the ACAI aeronautical mapping system can be applied effectively to aeronautical information services and procedure development as well as to automated map generation. C.C.S.

A92-38384**GPS/GLONASS USER SYSTEMS IN SWEDEN**

JOHNNY NILSSON (Swedavia, AB, Norrköping, Sweden) *Journal of Navigation* (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 258-265.

Copyright

A research and development program of a basic satellite navigation user system developed in Sweden, called the 'GP&C Total System' is presented. Details of the system are provided and show how it can serve as a basis for the tailoring of an almost endless number of applications. This system serves to illustrate how the navigation, communication and surveillance concept and the various elements for a new global Air Navigation System published by the ICAO FANS Committee can be implemented and integrated into a user-friendly operational system. R.E.P.

A92-40239**COMPUTATION OF AIRCRAFT GEOMETRIC HEIGHT UNDER RADAR SURVEILLANCE**

D. E. MANOLAKIS, C. C. LEFAS, G. S. STAVRAKAKIS (Technical University of Crete, Athens, Greece), and C. M. REKKAS (Athens, National Technical University, Greece) *IEEE Transactions on Aerospace and Electronic Systems* (ISSN 0018-9251), vol. 28, no. 1, Jan. 1992, p. 241-248. refs

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This paper describes a radar system for geometric height estimation of civil aircrafts. The system consists of one standard or mode S secondary surveillance radar (SSR) and one omnidirectional antenna sited away from SSR under an airplane. The geometric height is derived by trilateration. Systematic errors are compensated for by deriving the profile of the effect on height measurements of the bias in range measurements. A curve fitting technique is then used, which estimates both the geometric height and any non-zero systematic errors. Author

A92-43881**A COMPUTERIZED FLIGHT INSPECTION SYSTEM**

PEKKA ESKELINEN (Kotka Institute of Technology, Finland) *IEEE Aerospace and Electronic Systems Magazine* (ISSN 0885-8985), vol. 7, no. 3, March 1992, p. 5-11.

Copyright

This paper describes the key elements of a noncommercial computerized flight inspection system designed for testing of basic air navigation ground facilities. Choice of proper power supply, connection of different receivers, their characteristics, antenna installations and data processing algorithms are discussed in detail. Aircraft ground tracking techniques are considered together with achievable positioning uncertainty. It is shown that a simple BASIC-programmed controller together with IEEE-488-bus equipment and a theodolite tracker can provide a basis for measurements according to ICAO Annex 10 requirements. A new technique for measuring two frequency ILS-installations with a combination of communication test receivers is illustrated. Author

A92-45373**SELECTED MODELS OF AIRCRAFT NAVIGATION SPACE [WYBRANE MODELE SRODOWISKA NAWIGACYJNEGO LOTU]**

STEFAN BRAMSKI and JERZY GRAFFSTEIN (Instytut Lotnictwa, Warsaw, Poland) *Instytut Lotnictwa, Prace* (ISSN 0509-6669), no. 128, 1992, p. 16-37. In Polish. refs

A method for modeling aircraft navigation space is presented for use in a ground situated laboratory modeling aircraft flight dynamics, drive systems and aeronautical equipment. Principles

of mapping the geoid, the basic pressure distribution on the ground surface, parameter changes in the function of flight altitude under various climatic conditions, as well as modeling three components of atmospheric turbulence, the distribution of ground based radio navigation means, and the visibility of orientation objects on the ground for visual navigation have been accepted as essential elements of modeling the navigation space. Author

A92-48308**TIME-TO-GO ESTIMATION FROM INFRARED IMAGES**

K. C. MARKHAM (British Aerospace /Defence Systems/, Ltd., Bristol, England) *IEE Proceedings, Part I: Communications, Speech and Vision* (ISSN 0956-3776), vol. 139, no. 3, June 1992, p. 356-363. refs

Copyright

The problem of an aircraft flying toward a rendezvous point using passive image data to calculate the flight duration is considered. A technique is described which estimates time-to-go from a sequence of infrared images by applying a generalization of a conventional correlation process. The method relies on measurements from a multiple point correlation tracker, which is able to track a landmark or object. It is shown that a difference squared correlator is equivalent to the measurement equation of a parameter estimation scheme with tracking offsets as states. A simple relative motion model is postulated which uses magnification, rotation and translation, with the instantaneous measure of time-to-go related to the magnification scale factor. A series of experiments using simulated data is detailed and the results are discussed. In the latter stages of flight, the time-to-go estimates are shown to give acceptable results for many applications. Author

A92-48468**RADAR-OPTRONIC TRACKING EXPERIMENT FOR SHORT AND MEDIUM RANGE AERIAL COMBAT**

C. RAVAT, J. P. MESTRE, C. ROSE, and M. SCHORTER (Thomson-CSF, Puteaux, France) *IN: NAECON 91; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 360-366. refs*

Copyright

The combination of optronic and radar sensors significantly improves combat aircraft potential. After having studied the fusion and estimation algorithms required by this combination, Thomson-CSF has set up a ground experiment in order to evaluate the performance of a combined radar-optronic system in short and medium range aerial combat. A system of this type can be used in combination with fire-control systems (gun or missile). The experiment combines an RDM radar and an ATLIS TV tracking pod, and will be completed later with an ASPIC IRST (infrared search and track) sensor. The potential interest of the combined use of radar and optronics is presented with the experimental conditions and the main results obtained. I.E.

A92-50122**TERMINAL AREA TRAFFIC MANAGEMENT**

H. G. VISSER (Delft University of Technology, Netherlands) *Progress in Aerospace Sciences* (ISSN 0376-0421), vol. 28, no. 4, 1991, p. 323-368. refs

Copyright

The main theme in this article is the description of time-based traffic management procedures that have been proposed to increase the capacity of the air traffic system by the beginning of the next century. However, the article starts with a brief description of today's air traffic control systems. Their shortcomings are identified and the need for improved systems and procedures is discussed. The new technologies which will make it possible to overcome the limitations of the present communication, navigation and surveillance systems by providing higher quality and improved efficiency, are briefly discussed. Because terminal area management certainly is one of the most critical aspects of overall air traffic management, the main focus in this article is on this

issue. Finally, current research efforts toward improved trajectory optimization and control for flight operations in an extended terminal area are described in some detail. Author

A92-53239

MONOPULSE SECONDARY SURVEILLANCE RADAR AND THE MODE-S SURVEILLANCE SYSTEM [LE RADAR SECONDAIRE DE SURVEILLANCE A MONO-IMPULSION ET LE SYSTEME DE SURVEILLANCE MODE S]

FRANCIS BRANGIER (Centre d'Etudes de la Navigation Aerienne, Orly Aerogare, France) Navigation (Paris) (ISSN 0028-1530), vol. 40, no. 159, July 1992, p. 350-361. In French. refs Copyright

It is indicated that the present SSR system experiences a certain number of limitations including garbling, low accuracy, and overinterrogation. By employing new techniques such as monopulse SSR and mode-S SSR, many of these problems can be solved. The implementation of these techniques in various countries is discussed. R.E.P.

A92-53731

RADIOMETRIC CALIBRATION OF AN AIRBORNE C-BAND SYNTHETIC APERTURE RADAR

FRANZ HEEL, HERWIG OETTL, and MANFRED ZINK (DLR, Oberpfaffenhofen, Germany) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1989-1994. refs Copyright

Experimental radiometric calibration results are presented for an airborne SAR; these tests used 42 trihedral and four dihedral reflectors of various sizes and orientations. Radar cross section errors due to a reflector's environment were computed within the image pixel in question. Also tested was a prototype for a ground receiver and an active radar calibrator. Accounts are presently given of the experimental setup and of the errors due to aircraft motion, reflector tolerances, background clutter, and signal processing. O.C.

N92-10996# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

A SYSTEMATIC FORMULATION, AS AN APPROACH TO AIR TRAFFIC [DER LOESUNGSWEG FUEER DEN LUDVERKEHR HEISST SYSTEMISCHER ANSATZ]

H. FLECKENSTEIN 1991 27 p In GERMAN Presented at the Lufthansa DS-Symposium, Frankfurt, Fed. Republic of Germany, 6 Mar. 1991 (MBB-Z-0371-91-PUB; OTN-033124; ETN-91-90199) Avail: CASI HC A03/MF A01

A proposal for a new Lufthansa air traffic information system is presented. It is shown that the global formulation system air traffic is to be considered as a system between airport, aircraft and flight safety subsystems. The basic pattern of the system takes into account the following determining functions which are to be optimized in an iterative process: project management, project planning, reliability/quality safety, configuration management, and system engineering. The functional streams of an air traffic system are defined. The position determination process is the key of general traffic control processes. The tasks of a safety/security management are defined. The execution of operative workshops is recommended. ESA

N92-10997# Technische Univ., Berlin (Germany). Inst. fuer Luft- und Raumfahrt.

THE ELECTRONIC AERONAUTICAL CHART FOR GENERAL AERONAUTICS: A SYSTEM SPECIFICATION [DIE ELEKTRONISCHE LUFTFAHRKARTE FUEER DIE ALLGEMEINE LUFTFAHRT: EIN SYSTEMENTWURF]

MARIUS SCHLINGELHOF and DETLEF STOLZE 17 May 1991 54 p In GERMAN; ENGLISH summary (ILR-MITT-263(1991); ETN-91-90209) Avail: CASI HC A04/MF A01

A new concept for a low cost navigational computer, which

would provide new possibilities of increasing safety and reducing workload for pilots, is presented. An interface between computer and pilot can be provided by a moving map display making it unnecessary to trace flight paths with a finger on a paper map. A design of such a moving map display system is described. The aspects of software and hardware development, and the data acquisition problems are mentioned. ESA

N92-14018# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

DME GROWTH ELEMENTS AND THEIR USE WITH MLS

A. BECKER (Transport Canada Aviation, Ottawa, Ontario) In Communications Gillies, Inc., Electronic Systems in Transportation p 36-39 Sep. 1989

(Contract CNT PROJ. 6902)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The TIME Reference Scanning Beam System, selected by the International Civil Aviation Organization (ICAO) as the standard microwave landing system (MLS), provides vertical and horizontal guidance in an approach sector of plus or minus 60 deg. Development of a 360 deg azimuth element to be integrated with the MLS was recommended. This paper describes a distance measuring equipment (DME) based concept for this application. The system utilizes the unused pulse space in the conventional DME systems to provide a 360 deg guidance subsystem. The system provides aircraft with a 360 deg azimuth element to be integrated with the microwave landing system (MLS). When hardware components of precision DME (DME/P) technology are used, the azimuth 2 sigma error can be kept below 0.2 deg. This accuracy is quite satisfying for the envisaged application. After the aircraft has landed, the complete position of the aircraft can be detected with high accuracy. By using the full data link capability, the information needed for a roll guidance and airport surveillance system can be made available on the ground as well as in the air. CISTI

N92-19041# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

THE COMPAS SYSTEM IN THE ATC ENVIRONMENT

FRED V. SCHICK and UWE VOELCKERS Dec. 1990 164 p Annual DLR Inst. for Flight Guidance Scientific Seminar held in Brunswick, Fed. Republic of Germany, 12-13 Sep. 1990 Original contains color illustrations (ISSN 0939-298X)

(DLR-MITT-91-08; ETN-92-90729) Avail: CASI HC A08/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

Papers from the 1990 seminar, which focused on a particular Air Traffic Control (ATC) issue, automated planning aids for approach control, are presented. The intention of the seminar was to give a comprehensive view of the development of Computer Oriented Metering Planning Advisory System (COMPAS) and its operational application at the Frankfurt control center (Fed. Republic of Germany) Fundamental principles, operational implementation, field test results, and future plans were covered. ESA

N92-19042# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

DESIGN PRINCIPLES OF AUTOMATION AIDS FOR ATC APPROACH CONTROL

UWE VOELCKERS In its The COMPAS System in the ATC Environment 11 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

During the past decade several automation aids to assist controllers in approach control were developed in Western Europe and the U.S. While the principal functions and elements are very similar in all systems, the different developments show a variety of individual solutions, mostly with regard to the degree of

automation, the role of the human controller, the degree of detail of models and algorithms, and the design of the man-machine interface. The design principles and criteria of the Air Traffic Control (ATC) Computer Oriented Metering Planning Advisory System (COMPAS) are presented and compared with other solutions.

ESA

N92-19043# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

COMPAS SYSTEM CONCEPT

M. SCHUBERT *In its* The COMPAS System in the ATC Environment 19 p Dec. 1990 Original contains color illustrations

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

The management of arrival traffic has become one of the most difficult problems in air traffic control. The main objective of the Computer Oriented Metering Planning Advisory System (COMPAS) project was to find solutions and to gain experience in the application of a computer assisted system in the extended approach area. COMPAS was designed to help controllers in their planning and coordination functions and to efficiently merge the arrival traffic into Frankfurt airport (Fed. Republic of Germany). There is a series of models in the system which describe the air traffic control process, the economical flight profiles, the airspace structure plus the analytical method, and models for arrival sequencing. The COMPAS objectives, requirements, and models are described and the controller computer interface of the experimental system is considered in more detail.

ESA

N92-19044# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

EVALUATION OF THE COMPAS EXPERIMENTAL SYSTEM

FRED V. SCHICK *In its* The COMPAS System in the ATC Environment 17 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

For the evaluation of the functional capacity and the operational performance of Computer Aided Metering Planning Advisory System (COMPAS), traffic related aspects and human factors aspects were assessed in a series of experiments at Air Traffic Control (ATC) simulation facilities, with controllers as subjects. The evaluation was done in two major steps. The first step dealt with system layout. It resulted in an optimized design of algorithms, man/machine interface, and control principles of the system, which was in the second step submitted to a large scale evaluation, with more than 100 hours of simulation time. Three sources of data were used: traffic data, operational data of controller work, and controller judgements. The results indicated that COMPAS served as a helpful tool for reducing the effort for approach sequencing and for coordination. The guidance of approach traffic in the terminal area was facilitated by the planning system.

ESA

N92-19045# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

EXPERIENCES DEVELOPED IN TRANSFERING THE EXPERIMENTAL COMPAS SYSTEM TO AN OPERATIONAL PROTOTYPE VERSION

H.-D. SCHENK *In its* The COMPAS System in the ATC Environment 19 p Dec. 1990 Original contains color illustrations

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

To achieve the development and assessment of new systems, procedures and concepts to meet the requirements of the ongoing technical evolution, requires covering the areas from the first idea, to conceptional studies, up to simulations, investigations and assessments in simulated environments. In the development and assessment of the ATC (Air Traffic Control) planning system COMPAS (Computer Oriented Metering Planning Advisory System)

the step from transferring the results and outcomes from the experimental investigations into the development of an operational prototype version and its assessment under real operational conditions was undertaken. The special points of interest, problems and experiences found in this process based on the different requirements between the experimental and the operational system and their supporting environments are covered.

ESA

N92-19046# ATConsult, Frankfurt (Germany).

STEPS TOWARD ACCEPTANCE

K.-H. MINK *In DLR*, The COMPAS System in the ATC Environment 15 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

As air traffic controllers will continue to play the main role in Air Traffic Control (ATC), the achievement of acceptance is a prime concern when implementing new ATC system elements. Careful steps of increasing controller participation during all phases of system development and a continuous dialogue with the users is vital for successful implementation. The various steps taken during the COMPAS (Computer Oriented Metering Planning Advisory System) development as well as the lessons learned are described.

ESA

N92-19047# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

EVALUATION OF THE COMPAS OPERATIONAL SYSTEM

FRED V. SCHICK *In its* The COMPAS System in the ATC Environment 18 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

For an evaluation of the operational version of COMPAS (Computer Oriented Metering Planning Advisory Service) in terms of traffic flow, system operation and controller acceptance, a six month field test was carried out. The results indicated that the planning system enabled controllers to establish overall planned approach sequences; thereby contributing to straight and easy traffic flow as well as to the fairness of the final sequences. As regards the impact of COMPAS on controller work, there were distinct results obtained for APPROACH control and for the Area Control Center (ACC).

ESA

N92-19048# AEG-Electrocom G.m.b.H., Konstanz (Germany).

EXTENSION OF THE FRANKFURT COMPAS FOR GENERAL APPLICATION

W. PARTHIER *In DLR*, The COMPAS System in the ATC Environment 8 p Dec. 1990

Avail: CASI HC A02/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

A prerequisite for the maintainability and worldwide marketing of COMPAS (Computer Oriented Metering Planning Advisory System) is a standardized software basis and independence of hardware (e.g., Ada/UNIX). The system basis is outlined and the planned steps to modify the existing COMPAS-OP (adaptation of COMPAS for field tests in Frankfurt, Fed. Republic of Germany) to generate a more or less generally applicable COMPAS are described.

ESA

N92-19049# Bundesanstalt fuer Flugsicherung, Frankfurt am Main (Germany).

THE IMPACT OF COMPAS ON THE FUTURE COOPERATIVE AIR TRAFFIC MANAGEMENT CONCEPT (CATMAC)

K. PLATZ *In DLR*, The COMPAS System in the ATC Environment 17 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

A new concept for the future provision of air traffic services in Germany was developed. The concept is called the Cooperative Air Traffic Management Concept (CATMAC). CATMAC is

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

characterized by improved accuracy and higher reliability of planning data, and by adequate sharing of tasks between automated ground and airborne systems. The experience gained in the development and the operational evaluation of COMPAS (Computer Oriented Metering Planning Advisory System) were of great importance to the definition of the CATMAC concept. ESA

N92-19050# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. for Flight Guidance.
THE ROLE OF PLANNING SYSTEMS IN FUTURE AIR TRAFFIC MANAGEMENT

H. WINTER *In its* The COMPAS System in the ATC Environment 20 p Dec. 1990

Avail: CASI HC A03/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 Deutsche marks

In order to increase the productivity of air traffic control, the controllers have to be supported by computers. An analysis of the mental functions performed by the controllers was made and it is proposed to support the subfunction 'planning' by computers. The coupling between the time and space dimensions of planning makes distributed planning necessary. Global strategic and local tactical planning provide a largely conflict free planned traffic which will be monitored and controlled by the controllers. ESA

N92-19491# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

ESTIMATING THE PROBABILITY OF VERTICAL OVERLAP FROM THE PAIRED AIRCRAFT DATA OBTAINED IN THE EUROPEAN VERTICAL DATA COLLECTION USING THE PROGRAM DGLDIF

G. MOEK 8 Jul. 1988 182 p

(Contract RLD-LVB/L-24575)

(NLR-TR-88108-U; ETN-92-90954; AD-B159047L) Avail: CASI HC A09/MF A02

The problem of estimating the probability of vertical overlap in possible future airway systems with a vertical separation standard of 100 ft. above Flight Level 290 is addressed. It forms part of an overall safety assessment of such potential systems. The problem is solved by developing a mathematical probability model of the vertical distance between aircraft in a pair. A priori unknown model parameters are estimated by means of the maximum likelihood method from presently available data in the height keeping performance of aircraft in Europe based on the Double Generalized Laplace (DGL) probability distributions. Special attention is given to the effect on the modeling process of the limited amount of data on large height keeping errors. The point estimate obtained is 0.0000023 to 0.0000066 while an associated 95 pct. interval estimate is 0.0000148. ESA

N92-20611 Compagnia Italiana Servizi Tecnici, Rome.
STANDARDS AND S/W DEVELOPMENT ENVIRONMENTS; THE POINT OF VIEW OF A S/W ENGINEERING COMPANY INVOLVED IN SEVERAL SPACE PROGRAMS

E. ANCILLOTTO and R. BERNI *In* CNES, The Management of Large Software Projects in the Space Industry p 271-279 Jun. 1991 Previously announced in IAA as A91-47773

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Company capabilities involving integrated logistic support for air traffic control and navigation facilities, telecommunication systems, and satellite control centers and related ground infrastructures, are summarized. Software engineering for real time command and control, information management systems, remote sensing and image processing, and the system engineering services are summarized. The wide variety of standards and tools to be faced when involved with different projects and several customers is described. ESA

N92-20902# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany). Abt. Luft- und Raumfahrtpsychologie.

FLYING AN AIRCRAFT AS A PROBLEM-SOLVING PROCESS: ABOUT THE INSTRUMENT-FAILURE-SIMULATOR (IFS) AS A TEST FOR PILOT-CANDIDATES Ph.D. Thesis - Hamburg Univ. GERHARD FAHNENBRUCK Jun. 1991 117 p In GERMAN; ENGLISH summary (ISSN 0939-2963)

(DLR-FB-91-23; ETN-92-90738) Avail: CASI HC A06/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 38.50 DM

The IFS was developed on the basis of a theoretical model, showing how pilots fly. The simulator was equipped with instruments which systemically break down. The subjects had to fly and follow a relatively simple track several times, while scanning the instruments for failure. The performance was rated on the basis of the distance between the actual flight path and the given track, and on the ability to detect instrument failures. The results show that the IFS and the model can be used to predict professional success. The model can be used successfully to develop a test for airlines simulators. ESA

N92-21958# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

INTEGRATION OF FLIGHT AND CARRIER LANDING AID SYSTEMS FOR SHIPBOARD OPERATIONS

B. DANG VU, T. LEMOING, and P. COSTES *In* AGARD, Aircraft Ship Operations 15 p Nov. 1991

Copyright Avail: CASI HC A03/MF A03

The operational availability of a carrier depends to a large extent on the capacity of its equipment and its aviation to operate in a wide domain of meteorological conditions and sea states. Some equipments are under development for the future French nuclear carrier in order to extend its operational limits for aircraft launch and recovery: a deck motion tranquillization system, a deck motion prediction system, and an all-weather aircraft localization system. The impact on deck landing procedures for future carrier-based fighter aircraft is presented. An improved terminal guidance landing strategy making use of the prediction of the carrier motion is proposed. The actual glide path with fixed slope is replaced by a flight path along which the aircraft airspeed and flight path angle are updated in accordance with the predicted deck motion at touchdown, such that all the landing constraints are respected: minimum hook-to-ramp clearance, maximum touchdown sink rate.... The integration of the landing aid systems with the aircraft flight control system will allow the implementation of an automatic landing mode or advanced manual task-tailored control modes. Preliminary simulation results give a general idea on the improvement of deck landing performances with respect to the accuracy of the prediction of the carrier motion. Author

N92-21959# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).

APPROACH AND LANDING ASSISTED BY ONBOARD IMAGE PROCESSING [APPROCHE ET APPONTAGE ASSISTES PAR TRAITEMENT D'IMAGE EMBARQUE SUR AERONEF]

Y. LEGUILLOUX *In* AGARD, Aircraft Ship Operations 10 p Nov. 1991 In FRENCH

Copyright Avail: CASI HC A02/MF A03

A study is made of automation of visual control by an aircraft pilot during landing. The system that is envisaged, comprising one camera (infrared) and the associated electronics for real time image processing, will provide continuous 3-D representation of the aircraft's position in relation to the ship. To do this, the principal characteristics of the aircraft carrier are first localized in the image, then paired with their equivalents in the 3-D model of an a priori known aircraft carrier. By inverse perspective transformation, the pilot is able to determine the position of the ship relative to the aircraft, and from this information he can derive the position and movement of the aircraft relative to the ship. Thus, the system is able to measure the distance from an ideal landing scenario and from there the appropriate compensating actions can be

determined. Furthermore, the absolute movement of the aircraft, given by the inertial system, may be combined with the relative movement to give the absolute movement of the ship. Author

N92-21960# Royal Aerospace Establishment, Bedford (England).

APPROACH AND LANDING GUIDANCE

A. J. SMITH and E. J. GUIVER *In* AGARD, Aircraft Ship Operations 15 p Nov. 1991

Copyright Avail: CASI HC A03/MF A03

The final approach and landing of any aircraft operating from a ship is always a difficult task, even in benign conditions. Ship motion, adverse winds, and atmospheric attenuation compound the problems. High levels of integrity and reliability are an essential feature of any guidance aid in the ship environment since diversion facilities are often not available. Issues related to cost, maintainability, levels of training, and covertness further constrain the choice of guidance aid. The handling characteristics of the user aircraft and operational procedures also influence the choice of aid. To achieve the objective of regular and safe operations in all weather conditions, some form of guidance must be provided. The options range from painted markings and lighting systems that are used by the pilot to augment naturally occurring visual cues to precision radio or radar systems that are integrated into cockpit displays and flight control systems. In military operations there is a perceived need for passive or covert forms of guidance. The development of electro-optical sensors in recent years has increased the number of options and the availability of the Global Positioning System (GPS) will provide even more potential solutions to the design problems of providing precision guidance. The topics of approach and landing guidance has encouraged a large amount of research and development over the years, with many special-to-type solutions being devised. Except for the helicopter landing case, where relatively little research and development effort has been expended, the system designer is confronted with a large number of potential solutions. The above topics are addressed and conclusions are presented. Author

N92-25590# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung. **FLIGHT TEST OF AVIONIC AND AIR-TRAFFIC CONTROL SYSTEMS**

Jul. 1991 262 p *In* GERMAN; ENGLISH summary Presented at Scientific Seminar, Brunswick, Fed. Republic of Germany, 4-5 Jun. 1991 Report will also be announced as translation (ESA-TT-1279)

(ETN-92-91063) Avail: CASI HC A12/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

DLR aircraft and their basic measuring equipment are described. The possibilities of telemetric ground equipment for the preparation and evaluation of flight tests are described. The experimental cockpit Advanced Technologies Testing Aircraft System (ATTAS) and the Air Traffic Management and Operations Simulator (ATMOS) are presented. An experimental flight management system and the concept of a movement area guidance were tested. Concept, realization, and applications of a helicopter experimental platform are presented. A fault tolerant fly-by-light yaw control system was presented. The avionics flight evaluation system (AFES) is described. A board-autonomous flight trajectory measuring technique is presented. An experimental photoreconnaissance system is described.

ESA

N92-25595# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung. **ATTAS EXPERIMENTAL COCKPIT AND ATMOS FOR FLIGHT CONTROL COMPONENTS AND SYSTEMS INVESTIGATIONS [ATTAS EXPERIMENTAL-COCKPIT UND ATMOS FUER KOMPONENTEN- UND SYSTEMUNTERSUCHUNGEN DER FLUGFUEHRUNG]**

RALF BEYER *In its* Flight Test of Avionic and Air-Traffic Control Systems p 71-84 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The experimental cockpit ATTAS (Advanced Technologies Testing Aircraft System) and the air traffic control simulator ATMOS (Air Traffic Management and Operations Simulator) are presented. ATTAS and ATMOS represent an air traffic control test environment for the study of components and systems. Both systems, together with the data link between them, enable investigation in a realistic test environment of avionics and air traffic control systems, especially the interaction between airborne and ground systems.

ESA

N92-25597# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

TESTING CONCEPT OF A MOVEMENT AREA GUIDANCE

[ERPROBUNGSKONZEPT EINES ROLLFUEHRUNGSSYSTEMS]

A. BECKER *In its* Flight Test of Avionic and Air-Traffic Control Systems p 105-113 Jul. 1991 *In* GERMAN

Avail: CASI HC A02/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The concept of an experimental movement status and communication system for airfield surface traffic is outlined. The concept is based on the planning, control, and guidance system TARMAC (Taxi And Ramp Management and Control System). The requirements concerning movement status determination, digital communication, and position determination are discussed. The existing concepts cannot fulfill all these requirements and therefore an integrated system consisting of several subsystems is necessary.

ESA

N92-25600# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

GROUND AND SATELLITE SUPPORTED FLIGHT

TRAJECTORY MEASUREMENT BY EXAMPLE OF THE AVIONICS FLIGHT TEST SYSTEM AFES [BODEN- UND SATELLITENGESTUETZTE FLUGBAHNVERMESSUNG AM BEISPIEL DES AVIONIK-FLUGERPROBUNGSSYSTEMS AFES]

BERNHARD STIELER and KARLHEINZ HURRASS *In its* Flight Test of Avionic and Air-Traffic Control Systems p 177-206 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The avionics flight evaluation system (AFES) is described. Its basic sensors are a microwave radar and an inertial system. The measured signals onboard the aircraft are used in optimal estimation algorithms and provide quasi online and accurate reference trajectory calculation. The different components of the system are described. The position accuracy (horizontal and vertical) of the AFES reference system is discussed. The planned improvements (powerful airborne computer, integrated height measuring system, and global positioning system as support sensor) are outlined.

ESA

N92-25601# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

BOARD-AUTONOMOUS FLIGHT TRAJECTORY MEASUREMENT BY EXAMPLE OF AN ILS MEASURING SYSTEM [BORDAUTONOME FLUGBAHNVERMESSUNG AM BEISPIEL EINES ILS-VERMESSUNGSSYSTEMS]

BERNHARD STIELER and KARLHEINZ HURRASS *In its* Flight Test of Avionic and Air-Traffic Control Systems p 207-232 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The possibilities and advantages of a completely board-autonomous flight trajectory measuring technique are discussed. The basic components are an inertial system, barometric and radar height measuring systems, and CCD (Charge Coupled Device) cameras. The present ILS (Instrument Landing System)

system GFMS has to verify radio navigation systems for air traffic control. The concept of GFMS and the hitherto obtained results are discussed. Possibilities to improve the GFMS measuring system are given. Board-autonomous flight trajectory measuring systems supported by image processing are compared with ground and satellite supported systems. ESA

N92-27895# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Systemdynamik und Flugmechanik.

KNOWLEDGE-BASED PLANNING FOR CONTROLLED AIRSPACE FLIGHT OPERATION AS PART OF A COCKPIT ASSISTANT

T. PREVOT (Bundeswehrsanaetszentrum, Hamburg (Germany, F.R.)), R. ONKEN (Bundeswehrsanaetszentrum, Hamburg (Germany, F.R.)), and H.-L. DUDEK (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) / In AGARD, Air Vehicle Mission Control and Management 8 p Mar. 1992
Copyright Avail: CASI HC A02/MF A03

A knowledge based computer aid for flight planning tasks as part of a Cockpit Assistant for IFR (Instrument Flight Rules) operation is presented in detail after a brief overview of the modular structure of the Cockpit Assistant has been given. Based upon the requirements of air traffic management, the system is aimed at supporting the pilot in complex planning and decision situations. By assessing the situation, flight goal conflicts are detected and avoided by offering sensible flight plan modifications to the pilot. The main features of the situation assessment and planning module are discussed with regard to knowledge representation and applied solution model. Thus, conflict detection, selection of an alternate destination and rerouting algorithms are described in detail. The present state of implementation, as tested in a flight simulation facility at the University of the German Armed Forces in Munich, is presented as well as some results of the test phase with professional pilots. The possibilities of integrating the system into the avionics of modern aircraft are discussed and an outlook is given of expanding it towards 4-D and RNAV capability and/or optimal 3-D aircraft trajectory planning under constraints from terrain, traffic and weather. Author

N92-27897# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. of Flight Guidance.

ON BOARD PLANNING OF 4D-TRAJECTORIES

V. ADAM and R. KOHRS / In AGARD, Air Vehicle Mission Control and Management 12 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

The evolution of present day Air Traffic Management (ATM) towards an integrated Air Traffic Management will lead to the introduction of computer based planning systems on the ground side, which communicate with advanced Flight Management Systems onboard the aircraft via automatic data link. An experimental Flight Management System (EFMS) is under development in the frame of the PHARE program for research into future ATM concepts. This EFMS will have the capability to predict a 4-dimensional trajectory according to a set of constraints given by an ATC planning computer on the ground. It will negotiate this trajectory with ATC via data link and will generate appropriate guidance commands for the autopilot/autothrottle system to steer the aircraft along this trajectory. The functionality of the EFMS is described as well as the planning strategy for the generation of a trajectory from the departure to the destination airport which meets the defined constraint attributes. Author

N92-27905# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. of Flight Guidance.

IMPLEMENTATION AND OPERATIONAL EXPERIENCE WITH A NEW ARRIVAL TRAFFIC MANAGEMENT SYSTEM AT THE FRANKFURT ATC-CENTER

M. SCHUBERT and U. VOELCKERS / In AGARD, Air Vehicle Mission Control and Management 17 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

The DLR-Institute for Flight Guidance had developed a new Arrival Traffic Management System called COMPAS (Computer Oriented Metering Planning Advisory System). The system has

been implemented at the Frankfurt Regional Air Traffic Control Center in mid 1989 and is in continuous operation since then. A comprehensive implementation plan was developed in order to guarantee a smooth introduction, in particular with respect to both technical issues and controller acceptance. The experience gained and the lessons learned during the implementation process as well as the operational results are reported. Author

N92-29605# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

EUROPEAN STUDIES TO INVESTIGATE THE FEASIBILITY OF USING 1000 FT VERTICAL SEPARATION MINIMA ABOVE FL 290. PART 1: OVERVIEW OF ORGANISATION, TECHNIQUES EMPLOYED, AND CONCLUSIONS

J. M. TENHAVE, M. E. COX (Eurocontrol Agency, Brussels, Belgium), and D. A. FORRESTER (Meteorological Office, Bracknell, England) 18 Feb. 1991 27 p Submitted for publication (NLR-TP-91062-U-PT-1; ETN-92-91454) Avail: CASI HC A03/MF A01

Primarily in response to airline pressures for fuel economies, International Civil Aviation Organization (ICAO) established a study program to determine the feasibility of having the Vertical Separation Minimum (VSM) used above FL 290 to 1000 ft. The first of a three part article describing a European contribution to this program is presented. The aims and organization of the experimental work are outlined, the choice of methodology available to measure height keeping errors is described, and an indication of the measurement accuracy achieved is given. Overall, the work shows that, whereas it would be feasible to introduce a 1000 ft VSM in the North Atlantic region, other measures would be necessary before it could be used in continental airspace. Today, in certain areas, the need for a reduced VSM has become even more pressing in order to achieve the gains in airspace capacity necessary to handle rapidly growing volumes of air traffic. ESA

N92-29615# National Aerospace Lab., Amsterdam (Netherlands). Electronics Dept.

APPLICATION OF VME-TECHNOLOGY ON AN AIRBORNE DATA LINK PROCESSOR UNIT

P. J. H. M. MANDERS 6 Jun. 1988 15 p Presented at the VITA Conference on VME Bus in Research, Zurich, Switzerland, Oct. 1988

(NLR-MP-88040-U; ETN-92-91513) Avail: CASI HC A03/MF A01

The technical concept of a Data Link Processor Unit (DLPU), which is a five slot, VME based, computer system, is described. In civil aircraft the DLPU will interface a secondary surveillance radar mode select transponder with various avionics systems in order to support data link operations. A militarized 68020 processor board will be applied. The interfaces with the transponder and the avionic systems apply a 68000 microprocessor for handling the lower level protocols. Electrically the interfaces with the aircraft systems follow the ARINC specification 429. The requirements for volume, environment, performance and certification are described. The application of the VME bus technology made possible the use of standardized boards and application standardized methods for the multiprocessor communication. ESA

N92-32830# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

DEVELOPMENT OF NEW FLIGHT PROCEDURES FOR THE MICROWAVE LANDING SYSTEM (MLS)

L. J. J. ERKELENS 23 Apr. 1991 44 p Presented at the Sipke Wynia Symposium 1991 on Environmental Issues and Pollution in Aviation, Haarlem, Netherlands, 11 Apr. 1991 (NLR-TP-91156-U; ETN-92-92001) Avail: CASI HC A03/MF A01

The shortcomings of the current Instrument Landing System (ILS), which have led to the development of the Microwave Landing System (MLS), are summarized. The basic principles of MLS are outlined. The wide coverage volume of MLS, in both azimuth and elevation, enables new flight procedures to be defined, taking into account such patterns as noise abatement, obstacle clearance, and airspace restrictions. Research on developing approach, interception, and departure procedures for the MLS, which consists

of both flight trials with laboratory aircraft and flight simulator investigations on the research flight simulator, is outlined. Focus is on a recently completed flight simulator investigation on operational curved approach feasibility for a wide body type of aircraft. The test objectives of the 1990 flight simulation program are discussed. ESA

N92-70564 National Aerospace Lab., Amsterdam (Netherlands). PROCURU SIMULATION RESULTS COMPARED WITH METRO 2 IN-FLIGHT ILS APPROACH DATA

J. VISSER 22 Dec. 1987 124 p Sponsored by Netherlands Agency for Aerospace Programs (PB92-138502; NLR-TR-87180-U) Avail: CASI HC A06/MF A02

The Procedure Oriented Crew (PROCRU) model was developed for the analysis and modeling of flight crew procedures during an instrument landing system (ILS) approach. The model's specific capability concerns the generation of timelines of the necessary actions to be carried out by each crew member during the approach. The corresponding timelines for other relevant variables can be generated by the model, reflecting among other things the aircraft's position relative to the runway, its altitude speed, information presented, etc. The objective here is to analyze the model's applicability by comparing model results with actual inflight approach data. The approaches were flown with the Swearingen Metro II research aircraft. The obtained data allowed useful comparisons with PROCURU generated data. The model results show an acceptable degree of accuracy with respect to the prediction of timelines of the relevant events in the approach, as well as with respect to the computed flight path profiles. The study also reveals a number of weaknesses in the model which are inherently related to aspects of the model implementation in the computer program. Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A92-10666

FLYING THE A340 IRON BIRD

HARRY HOPKINS Flight International (ISSN 0015-3710), vol. 140, Oct. 2, 1991, p. 24-26.

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An overview is presented of the three A330/A340 simulation cabs, clustered near the 'iron bird' control rig and avionics test cells, which can be partially interconnected to them, principally by the use of optical fibers. Software production both for displays and for the new flight management guidance and envelope computer is accomplished on a CAD/CAM tool. A fourth simulator is used almost entirely for the preparation of control laws, also involving CAD/CAM. Attention is given to a simulated demonstration flight with a description of the handling characteristics observed. R.E.P.

A92-11882

DORNIER DO.328 SPECIAL - EXAMINING THE HIGH-SPEED COMMUTER

JULIAN MOXON, DOUGLAS BARRIE, and IAN GOOLD Flight International (ISSN 0015-3710), vol. 140, Oct. 9, 1991, p. 31-34, 36-40.

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A review is presented of the new Do.328 30-seat high-speed commuter aircraft that seeks to capture a significant portion of the market. Vital to its enhanced performance is the shape of the fuselage, wing-fuselage, and undercarriage fairings, and the high power provided by two PW119 turboprops with six-bladed propellers. The dual-acting propeller system uses a piston in the hub, capable of adjusting pitch to maintain constant engine rpm

and also to feather the blade when necessary. Attention is given to the integrated cockpit system, structural cost and performance, and cabin design aims and configuration. R.E.P.

A92-14398

STUDYING DYNAMIC BEHAVIOR OF X380 HELICOPTER EQUIPPED WITH A NEW 5-BLADE COMPOSITE ROTOR

CHRISTOPHE SERR and MICHEL TROUVE (Aerospatiale, Division Helicoptere, Marignane, France) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 997-1007. refs Copyright

Flight testing of the X380 Dauphin demonstrator showed excellent vibratory comfort. The vibration level measured in flight without suspension system and with the new 5-blade rotor is better than on a conventional Dauphin with a 4-blade StarFlex rotor and suspension. The completely new 5-blade rotor design consists of a tapering composite material rotor mast and a SpheriFlex rotor head with elastomeric interblade dampers. The low vibration levels measured on the X380 are primarily attributable to the quality of the rotor and to the airframe excitation transmission characteristics. Author

A92-14416

THE EUROFAR VEHICLE OVERVIEW

VITTORIO CARAMASCHI (Agusta S.p.A., Varese, Italy) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1213-1236. refs Copyright

This study examines the status of the Eurofar program, the aim of which is to introduce a tilt-rotor vehicle in the civil air transport scenario, focusing on all the technical, economic, and operational aspects to be considered to achieve the project's effective viability. Attention is given to the need for the program, the evolution of the air-transport project, the tilt-rotor system, the novelties of this project, its actual integrated plan, and the flight of the Demonstrator aircraft. An extended overview of the actual baseline aircraft, the concurrent technologies applied, and the experiments to be performed is given. The goals of the project's next phase are discussed. P.D.

A92-16058

JAS 39 GRIPEN PROGRESS REPORT

ARNE LINDHOLM (Saab-Scania, AB, Linkoping, Sweden) IN: 1990 report to the aerospace profession; Society of Experimental Test Pilots, Symposium, 34th, Beverly Hills, CA, Sept. 27-29, 1990, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1990, p. 109-116.

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The JAS 39 Gripen is a multirole lightweight combat aircraft capable of takeoff and landing operations on ordinary roads. The Gripen employs a full-authority triplex flight control digital system with triplex analog backup. Attention is given to the nature of the accident that occurred during the test flight aircraft's sixth landing, and the lessons derived from it for subsequent flight tests. Flight test functions have been incorporated by the flight control system in order to ensure the reproduction of steps, doublets, and frequency-sweeps during flights. O.C.

A92-16622

MIRAGE 2000-5 - DASSAULT'S DELTA DESCRIBED

GILBERT SEDBON Flight International (ISSN 0015-3710), vol. 140, Nov. 20, 1991, p. 41-45.

Copyright

A review is presented of the major technical features incorporated in the Mirage 2000-5 fighter aircraft with the particular aspects influenced by the international market. Attention is given to details of this single-seat air-defense fighter (or two-seat trainer), including the FBW system, the powerplant, weights and dimensions, typical armament, and performance. R.E.P.

A92-18001

TOMORROW'S GOSHAWK FLIES

JOHN FARLEY Flight International (ISSN 0015-3710), vol. 140, Dec. 4, 1991, p. 32-35.

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A review is presented of the U.S. Navy's new T-45A jet trainer flight characteristics and the improved modifications incorporated for acceptable carrier takeoff and landing capability. Attention is given to the five major modified areas: engine/aircraft performance, stall characteristics, longitudinal stability, speedbrake effectiveness, and pitch transients and lateral/directional stability. The fixes involved changing to an existing higher-thrust variant of the Adour, fitted with a specially-modified fuel control system to reduce engine acceleration times, fitting a fast-idle throttle stop for use on the approach, and designing a higher-lift version of the wing incorporating retractable leading-edge slats. R.E.P.

A92-19819

DAMAGE TOLERANCE OF THE FIGHTER AIRCRAFT 37

VIGGEN. I - ANALYTICAL ASSESSMENT. II - EXPERIMENTAL VERIFICATION

BJORN PALMBERG, PER-OLOF BOMAN, MATS-OLOF OLSSON, and ANDERS F. BLOM (Aeronautical Research Institute of Sweden, Bromma) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2227-2238. Research supported by Defence Material Administration of Sweden. refs

Copyright

The damage tolerance of the 37 Viggen fighter aircraft is analyzed. Load spectra are presented along with the results stress analysis, fracture mechanics, and fatigue crack propagation. The results of analysis are successfully verified by a comparison with experimental results from damage-tolerance tests on the wing attachment frame of 37 Viggen and on the fin of a newer version of this aircraft, the JA 37 Viggen. It was found that the tested components were damage tolerant during the original fail safe design lives. I.S.

A92-20134

WHOLE AIRCRAFT LIGHTNING INDIRECT EFFECTS EVALUATION USING LOW LEVEL INJECTION TECHNIQUES

S. J. HOLDEN (Aeroplane and Armament Experimental Establishment, Salisbury, England), D. T. JORDAN (Royal Aerospace Establishment, Farnborough, England), and E. G. STEVENS (ERA Technology, Ltd., Leatherhead, England) International Conference on Lightning and Static Electricity, University of Bath, England, Sept. 26-28, 1989. 9 p. refs

Copyright

The responses of an aircraft and its cable bundles to free-field illumination from a transient EM field can be ascertained by means of a technique which uses the data acquired from low-level, swept-frequency carrier wave (LLSFCW) EM field-coupling measurements. An investigation has accordingly been conducted into techniques for injecting LLSFCW and transient currents into an aircraft that is enclosed in an external coaxial return conductor system, in order to evaluate return-conductor systems and compare the results of low level CW injection with high and low level pulse injection. Attention is given to the extrapolation of the low-level injection techniques for the clearance of aircraft for indirect lightning-strike effects. O.C.

A92-20136

THE USE OF FINITE DIFFERENCE ELECTROMAGNETIC ANALYSIS IN THE DESIGN AND VERIFICATION OF MODERN AIRCRAFT

B. I. WAHLGREN, M. G. BACKSTROM (Saab-Scania, AB, Linköping, Sweden), R. A. PERALA, and P. M. MCKENNA (Electro Magnetic Applications, Inc., Lakewood, CO) International Conference on Lightning and Static Electricity, University of Bath, England, Sept. 26-28, 1989. 9 p. refs

The numerical EM modeling of aircraft and such interior

elements as equipment bays and cabling has in the last decade reached a high stage of sophistication as a design and verification tool, in conjunction with high-speed large-memory computation resources. Attention is presently given to illustrations of the usefulness and accuracy of such modeling in the case of lightning strikes, which are EM phenomena too complex to simulate through ground testing. The effects of lightning on 3D surfaces and carbon fiber-reinforced polymer composite structures of the JAS39 fighter are noted. O.C.

A92-20203

FOUR DECADES OF TRANSONIC FIGHTER DESIGN

RAY WHITFORD (Cranfield Institute of Technology, Shrivvenham, England) Journal of Aircraft (ISSN 0021-8669), vol. 28, Dec. 1991, p. 805-811. Previously cited in issue 22, p. 3649, Accession no. A88-51960. refs

Copyright

A92-22473

INTERNATIONAL STANDARDISATION OF REGULATIONS FOR GUST LOADING CALCULATIONS

J. M. SAUCRAY, C. ARTIGUES, G. SQUEGLIA (Aerospatiale, Toulouse, France), and J. GUILLOT (Toulouse, Institut National des Sciences Appliquées, France) Aeronautical Journal (ISSN 0001-9240), vol. 95, Dec. 1991, p. 370-378. refs

Copyright

Calculation methods are presented for the preliminary dimensioning, substantiation, and certification of aircraft for gust loading airworthiness, as well as for the assessment of advancements made in recent years on the bases of aircraft response studies and comparisons of their results with calculated loads. The current international regulatory requirements are broadly directed toward standardization, thanks to the insistence of both the airworthiness authorities and the aeronautical industry. Attention is given to the airworthiness-discrete tuned gust method. O.C.

A92-22474

GUST EFFECTS ON A FLEXIBLE AIRCRAFT

P. SANTINI and P. GASBARRI (Roma I, Università, Rome, Italy) Aeronautical Journal (ISSN 0001-9240), vol. 95, Dec. 1991, p. 379-384. refs

Copyright

An investigation is conducted of the influence of the structural stiffness of aircraft on their response to atmospheric turbulence, comparing unsteady and quasi-steady aerodynamics. Attention is given to the power spectral density approach, for which the turbulence power spectrum must be given; aircraft response is then evaluated via the classical theory of random vibrations. Pade's approximation, the integral equation of motion, is noted to be reducible to a differential system which is more computationally tractable. O.C.

A92-25074

TILTING AT TARGETS

GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, Feb. 5, 1992, p. 42-45.

Copyright

An overview of tilt-rotor and tilt-wing technology that has been test-flying for some 30 years is presented and the problems facing the developers are discussed. Consideration is given to the V-22 Osprey military tilt-rotor transport, the TW-68 9/14 seat corporate/commuter tilt-wing aircraft, the CL-84 tilt-wing technology demonstrator, and various engine/propeller combinations. R.E.P.

A92-26550

ELEMENTS OF AIRPLANE PERFORMANCE

G. J. J. RUIJGROK (Delft University of Technology, Netherlands) Delft, Netherlands, Delft University Press, 1990, 461 p. refs

(ISBN 90-6275-608-5) Copyright

A comprehensive account is given of methods for the prediction of aircraft performance. After establishing the application of Newton's law of motion to an earth-related axis system, attention is given to the character of the atmospheric medium, the equations

of motion, lift-drag polars, types of aircraft and their propulsion systems, performance in steady symmetric flight, altitude effects, and turning performance. Also treated are gliding flight characteristics, symmetric climb and descent, cruise performance projection, and airfield performance characteristics. O.C.

A92-26849

THE COCKPIT OF A MODERN AIRCRAFT - THE AIRBUS A340 CONSIDERED AS AN EXAMPLE [LE POSTE DE PILOTAGE D'UN AVION MODERNE - EXEMPLE DE L'AIRBUS A340]

J. GROSSIN (Aerospatiale, Toulouse, France) (Congres International des Instituts de Navigation, 7th, Cairo, Egypt, Oct. 23-27, 1991) Navigation (Paris) (ISSN 0028-1530), vol. 40, Jan. 1992, p. 57-69. In French.

Copyright

The A340 and A330 are cited to exemplify the advanced concepts of the modern transport aircraft cockpit. Attention is given to the forward facing crew cockpit, the electronic centralized aircraft monitoring system, the full authority digital engine control, and the radio management panel. Illustrative panels and layouts are provided with descriptions for the FBW system, the maneuver load alleviation system, and the electronic library system. R.E.P.

A92-30091

DORNIER 328 - A DAIMLER FOR COMMUTERS

GORDON SWANBOROUGH Air International (ISSN 0306-5634), vol. 42, March 1992, p. 123-128.

Copyright

A review is presented of the commercial requirements and engineering development planning leading to the final configuration of the Dornier 328 commuter aircraft. Attention is given to the basic specifications including the two turboprops of 2,300 shp each, six-bladed propellers, 345 kts max cruise speed, 700 nm range with 30 passengers and flight crew of two, max payload of 7,600 lb, and all dimensions listed and illustrated in a full cutaway drawing. Consideration is given to the cockpit layout, the advanced avionics incorporated and the aluminum alloys, carbon-fiber reinforced plastics, Kevlar, glass-fiber-reinforced plastic, and titanium airframe sections utilized. R.E.P.

A92-31691#

AERO-PROPULSIVE EFFECTS ON CONFIGURATION SHAPING

L. H. TOWNEND, E. G. BROADBENT, J. F. CLARKE, R. A. EAST, T. R. F. NONWEILER, G. PAGAN, E. A. PARKER, and J. PIKE (Advanced Propulsion and Energy Control Systems, Ltd., Liss, England) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 15 p. Research supported by Ministry of Technology of England, USAF, and McDonnell Douglas Corp. refs

(AIAA PAPER 91-5064) Copyright

This paper presents a short account of some design methods which may assist the practical and efficient achievement of hypersonic flight. Design methods are outlined by which the component parts of hypersonic airbreathing vehicles (such as the X-30) can be aerodynamically optimized either in isolation or as integrated combinations of structurally realistic geometry. Other methods are illustrated in application to the analysis of fluid features such as the flow around base areas, and beneath supersonic and hypersonic wings, both with and without external mass and heat addition, for typical vehicles such as airbreathing first (and airbreathing second) stages of a TSTO. Other methods describe passive cooling of leading edges and the installation of intakes on volumetrically efficient forebodies which offer low drag and may also permit simplifications in the handling of intake/forebody boundary layers. Author

A92-32325

THE FIRST FIFTY YEARS OF COMPOSITE MATERIALS IN AIRCRAFT CONSTRUCTION

D. H. MIDDLETON Aeronautical Journal (ISSN 0001-9240), vol. 96, March 1992, p. 96-104. refs

Copyright

The course of development of aircraft primary structure

composite construction methods since 1940 is discussed, giving attention to major milestones in both matrix and reinforcing materials composition and fabrication methodology. Although a composite aft fuselage of flax-reinforced phenolic resin was successfully manufactured for a Spitfire fighter in 1940, it was not until 1977 that an all-composite aircraft, the graphite-reinforced epoxy 'Learfan' business jet, flew. Weight-minimizing advanced composites are of critical importance to swept-forward wing aircraft such as the X-29, and all high performance tilt-rotor and rotary-wing VTOL aircraft. O.C.

A92-33326#

SENTINEL 1000 FLIGHT TEST PROGRAMME OVERVIEW AND PRELIMINARY RESULTS

K. R. NIPPRESS and B. WILSON (Westinghouse Surveillance Systems, England) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 10 p. refs
(AIAA PAPER 92-1229) Copyright

This paper presents an overview of the Sentinel 1000 flight test program and discusses some of the results obtained from the initial phase. The Sentinel 1000 airship is the largest and most advanced nonrigid airship in the world under active flight development. Some of the peculiarities of testing a lighter-than-air vehicle, which cause complications compared with conventional aircraft work, are explained in describing the work. There is significant commonality between this airship and the much larger and more complex Sentinel 5000 airship currently being designed under U.S. Government contract. The Sentinel 1000 is considered to have potential design risk reduction for this project. Author

A92-33344#

THE DESIGN CHALLENGE OF A LONG ENDURANCE AIRSHIP

J. R. MUNK and R. H. HILLSDON (Westinghouse Surveillance Systems, England) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 8 p.
(AIAA PAPER 92-1266) Copyright

The U.S. Navy's airship program is discussed with emphasis placed on surveillance requirements, airship sizing, and the engineering problems associated with the driving design parameters. Generic military requirements under consideration include altitude, speed, endurance, temperature range, and mission payload. Analysis of the normal range of size driving parameters suggests that the majority of surveillance requirements for long endurance aircraft can be met with a nonrigid airship well within the threshold of technical risk. O.G.

A92-33919

AIRCRAFT PERFORMANCE

W. A. MAIR (Cambridge, University, England) and DAVID L. BIRDSALL (Bristol, University, England) Cambridge, England and New York, Cambridge University Press (Cambridge Aerospace Series, No. 5), 1992, 320 p. refs
(ISBN 0-521-36264-4) Copyright

Aircraft performance estimation studies entail calculation of such factors as rates of climb, maximum and cruise speeds, range for a given mass of fuel, and runway lengths required for takeoff and landing. A comprehensive account is presently given of the relationships between these quantities and the design characteristics of an aircraft and its powerplant, with emphasis on the derivation of simple analytical expression which depend solely on such fundamental aircraft properties as mass, wind tunnel or flight test-derived lift and drag coefficients, and engine thrust characteristics over the given range of speeds and altitudes. Only fixed-wing aircraft are considered, and little prior knowledge of aircraft is assumed. O.C.

A92-34650

MASS-TRANSPORTER

SIMON ELLIOTT Flight International (ISSN 0015-3710), vol. 141, April 1, 1992, p. 22, 23, 26-28.

Copyright

A critical survey is presented of next-generation high passenger capacity commercial aircraft configurations currently under

evaluation, with attention to the ovoid, circular, horizontal 'double-bubble', and 'clover leaf' fuselage cross-sectional shapes through which seating-arrangement densities are to be maximized. The configurations, at their most conservative, expand existing B 747 and Airbus airframes to reach 600 passengers; all-new designs are expected to be able to seat as many as 1000 passengers. Nearly all configurations are four-engined, attempt to fit existing airport-infrastructure dimensions, and use double-deck seating.

O.C.

A92-35434

JPATS ESCAPE SYSTEM DEVELOPMENT

KEN R. YATES (Martin-Baker Aircraft Co., Ltd., Middlesex, England) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 36-42.

Copyright

The Joint Primary Aircraft Training System (JPATS) program is discussed with particular attention given to the development of the MK16L ejection seat. The MK16L lightweight variant ejection seat is a twin catapult, fully automatic cartridge operated seat with rocket assistance, which provides safe escape throughout the envelopes stipulated in MIL-S-9479B and MIL-S-18471F. It is based on the latest advances in seat propulsion, stabilization, and recovery technology in conjunction with the JPATS requirements for accommodation of the full percentile range of male and female aircrew with minimum installed weight and low cost.

O.G.

A92-35734

THE DEVELOPMENT OF A NEW LIGHT, SINGLE ENGINE HELICOPTER FAMILY

M. RUSSIER and B. PLISSONNEAU (Aerospatiale, Division Helicopteres, Marignane, France) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 13 p. refs

The paper describes the design and development of P 120L, the first product of the P 120 light single-engine helicopter family, which will include most advanced light-helicopter proprietary technologies. Consideration is given to the operational needs of the helicopter and the proposed characteristics; the technological concepts, the P 120L architecture, and the hub technology; the main rotor blade and the fenestron rail rotor designs; the fenestron technology; the engine; and the avionics of P 120L.

I.S.

A92-35738

THE USE OF INVERSE SIMULATION FOR CONCEPTUAL DESIGN

D. G. THOMSON and R. BRADLEY (Glasgow, University, Scotland) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 15 p. refs

The calculation of the control inputs required to fly a predefined maneuver is known as inverse simulation. When the mathematical model used is generic, inverse simulation can be used to measure the effect on the performance of the helicopter due to parametric changes. The choice of which maneuvers are to be simulated is made easier by referring to the U.S. Aeronautical Design Standards for the handling qualities of military rotorcraft which defines a series of Mission Task Elements to be flown within specified performance limits. Mathematical representations of some of these maneuvers are developed in this paper, and the use of inverse simulation for design purposes is demonstrated by a series of simulations of a hypothetical helicopter configuration flying them.

Author

A92-35750

EUROFAR AIRFRAME AERODYNAMIC DESIGN

THIERRY BILANGE (Aerospatiale, Division Helicopteres, Toulouse, France), PHILIPPE ROLLET (Aerospatiale, Division Helicopteres, Marignane, France), YVON VIGNERON (Aerospatiale, Division Helicopteres, Toulouse, France), and GIUSEPPE PAGNANO (Agusta S.p.A., Cascina Costa di Samatate, Italy) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 13 p. refs

The paper outlines the aerodynamic airframe design performed

during the EUROFAR preliminary feasibility phase. Attention is given to parametric studies giving a first baseline configuration and to efforts to refine the wing's preliminary design. Several other configurations were selected for wind tunnel tests and trade-off activities. Experimental results, along with computer codes for aerodynamics and flight mechanics prediction and configuration selection, allowed the baseline refinement to be carried out. General trade-offs, such as wing location or tail and engine configuration, were conducted, followed by wing profile improvement and optimization of the overall aircraft configuration. The adaptation of design methods and computation codes to the tilt-rotor aircraft is discussed.

P.D.

A92-35752

TAIL ROTOR AERODYNAMIC FEATURES RECORDED IN FLIGHT

A. D. S. ELLIN (Royal Aerospace Establishment, Bedford, England) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 21 p. refs

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Effects of main rotor-tail fin interactions are apparent in the instrumented Puma rotorcraft tail rotor blade trials reported; they are illustrated by frequency spectra and polar contour plots of tail rotor pressure coefficients. The removal of a segment of the main rotor tip loading peak by the influence from the tail rotor is included from previous main-rotor test results, and compared with a similar effect observed on the tail rotor. Attention is given to problems caused in the analysis of these types of data by variations in tail rotorblade chordwise velocity.

O.C.

A92-35767

ROTOR AEROMECHANICS RESEARCH WITH THE RAE RESEARCH LYNX - THE EXPERIMENTAL FACILITY AND TEST PROGRAMME

P. C. TARTTELIN (Royal Aerospace Establishment, Bedford, England) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 19 p. refs

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The instrumentation and flight test program for the RAE Bedford Lynx are described. The aircraft instrumentation includes an instrumented tail rotor, a helicopter air data system to enable low airspeed measurement, and a control input device to provide a means for injecting preprogrammed control inputs in a precise and repeatable manner. The test program is to include trims and dynamic response in steady and maneuvering flight to support aeromechanics model validation for performance, loads, and flying qualities. The data are gathered using an on-board data recording system, and a set of programs permits data handling and analysis. The lessons learned from experience with similar measurements on the RAE research Puma are reviewed as well.

P.D.

A92-35771

LAH MAIN ROTOR MODEL TEST AT THE DNW

J. W. G. VAN NUNEN, C. HERMANS (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands), and H.-J. LANGER (DLR, Brunswick, Federal Republic of Germany) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 10 p. refs

Results are presented from a wind tunnel experiment executed in the German-Dutch Windtunnel on a dynamically and Mach scaled model of the A 129 LAH main rotor. Four different rotor configurations were examined, with the variations being either in the blade tip shape or in the twist distribution along the span of the blade. Results show that the dynamic characteristics of the various blade configurations agreed reasonably well, with exception of blade configurations that have swept back tips. These blades exhibited lower torsional frequencies than those by comparable blades with straight tips. The rotor torque measured on the model rotor correlated up to 130 kts with the torque determined during flight tests.

I.S.

A92-35774

GENERAL MODEL OF ISOLATED HELICOPTER BLADE FOR STABILITY INVESTIGATION

JANUSZ NARKIEWICZ and WIESLAW LUCJANEK (Warsaw University of Technology, Poland) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 15 p. refs

A model of a helicopter blade was developed to investigate the effect of the hub and blade arrangements on the rotor blade motion. In the analysis, the isolated rotor blade (which can be rigid or deformable) of a helicopter in steady flight is considered; the hub can be hingeless or have up to three hinges of arbitrary sequence, with stiffness and damping present in each hinge. The aerodynamic loading is calculated in the framework of strip theory using steady nonlinear airfoil characteristics with unsteady effects described by a dynamic inflow model. Equations of motion, derived from Hamiltonian principle, are included into the set of computer codes designed to perform comprehensive stability analysis of helicopter motion. I.S.

A92-35780

DESIGN AND MANUFACTURING OF TORSIONAL FLEXIBLE BLADE MODELS

F. DUPRIEZ, P. GEOFFROY, and B. PALUCH (ONERA, Institut de Mecanique des Fluides de Lille, France) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 10 p. refs

This paper concerns manufacturing and design of instrumented blade models with specified torsional flexibility and straight removable tip, which will be tested in the ONERA Chalais wind-tunnel. The purposes are to take into account the torsional deformation of the blades in order to increase helicopter rotor performance, and to improve and fit the calculation codes relative to aeroelastic deformation and aerodynamic load during hover and forward flight. An iterative procedure is employed to determine the blade's internal distribution of composite material layers, and to obtain a value of tip end torsion angle close to ± 3 deg during a rotation. Six material configurations are tested before a good agreement is found. To avoid strong couplings between modeshapes, this removable blade-tip joint is realized with two specific metallic inserts. The blades are instrumented with a particular strain gauge disposition, in order to measure their deflection during wind tunnel tests. Author

A92-35937

HANDLING AND PERFORMANCE CONSIDERATIONS WHEN CONDUCTING AIR-TO-AIR REFUELLING OF LARGE AIRCRAFT BY THE PROBE AND DROGUE SYSTEM

JOHN BRADLEY (Aeroplane and Armament Experimental Establishment, Boscombe Down, England) IN: Society of Flight Test Engineers, Annual Symposium, 21st, Garden Grove, CA, Aug. 6-10, 1990, Proceedings. Lancaster, CA, Society of Flight Test Engineers, 1990, p. 3.2-1 to 3.2-24.

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The flight environment required for the air-to-air refueling of large aircraft is examined within the context of the probe-and-drogue system. Attention is given to the longitudinal handling and lateral/directional handling required within the service envelope for this refueling. Trim changes are described in the receiver and the tanker that are required for typical handling situations, and phenomena such as engine surge and vibration are described which impinge on the refueling procedure. The receiver is required to increase power during air-to-air refueling so that it can penetrate the downwash field from the tanker and overcome the drag associated with making contact with the drogue. All the aircraft combinations described in the paper are able to refuel in the air, although some have limitations due to handling characteristics and/or stressing conditions. C.C.S.

A92-35940

FOKKER 50 FLAMEOUTS IN ICING CONDITIONS

J. M. J. A. NICOLAES (Fokker Aircraft, Amsterdam, Netherlands) IN: Society of Flight Test Engineers, Annual Symposium, 21st,

Garden Grove, CA, Aug. 6-10, 1990, Proceedings. Lancaster, CA, Society of Flight Test Engineers, 1990, p. 3.6-1 to 3.6-6.

Copyright

The accumulation of ice on the Fokker-50 intake assembly is investigated with observations to determine the deficiencies of simulated ice-testing in wind tunnels. A miniature video camera is installed on the intake assembly that does not obstruct the airflow and allows the in-flight monitoring of ice accumulation. It is shown that wind-tunnel tests do not sufficiently account for the propeller's influence on the flow behavior and that it is not possible to understand the mechanism of ice accretion without the video monitoring. The intake behavior is found to be significantly affected under flight conditions that include hail and wet snow in combination with light-moderate icing conditions. The results are employed to modify the intake so that the icing condition is mitigated; the results demonstrate the efficacy of using video technology to study icing in a way that cannot be simulated in a wind tunnel. C.C.S.

A92-37074

USE OF THE THRUST-WEIGHT DIAGRAM VERSUS TRANSPORT CARGO IN THE INITIAL DIMENSIONING OF PASSENGER-TRANSPORT AIRCRAFT [UTILIZACION DEL DIAGRAMA EMPUJE PESO FRENTE A CARGA ALAR EN EL DIMENSIONADO INICIAL DE AVIONES DE TRANSPORTE DE PASAJEROS]

J. S.-T. MARTIN and T. M. CANDEL (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 33-40. In Spanish. refs

Copyright

Attention is given to the use of the diagram relating transport cargo with the thrust-weight ratio in the conceptual design of aircraft. Specific treatment is given to the use of this design constraint for several classes of aircraft. The analytical technique is based on the work by Roskam (1985) and Torenbeek (1976) and employs linear expressions to describe the parameters of the aircraft dimensions. Equations relating the thrust-weight ratio and cargo are appropriated from the literature and from mechanical expressions for maximum range and velocity and takeoff and landing distance. The expressions delimit the regions that contain possible design points for the aircraft, the possible load fractions, and potential fuel fractions. The present analytical technique can be used to determine the design variables required to give the initial specifications of an aircraft. C.C.S.

A92-37874

RAFALE M - DASSAULT'S SQUALL AT SEA

JOHN FRICKER Air International (ISSN 0306-5634), vol. 42, no. 5, May 1992, p. 233-239.

Copyright

A review is presented of the French Rafale M, the naval variant of the new multirole fighter that is destined to replace the ageing carrier based F-8 Crusaders presently deployed. Consideration is given to the overall design and development program as it evolved through various designs and modifications beginning with the original Eurofighter consortium EFA program. Attention is given to development of the 16,850 lb afterburning design thrust of the low bypass-ratio turbofan engines, as well as performance, weights, armament, and avionics/radar of the aircraft. R.E.P.

A92-39082

PROPELLER AIRCRAFT INTERIOR NOISE - PHYSICAL BACKGROUND AND POSSIBLE TREATMENTS

PETER GORANSSON (Aeronautical Research Institute of Sweden, Bromma) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 805-810.

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Analytical treatment is given to the propeller as a noise source within the structural-acoustic system of aircraft with reference to proposed noise-reduction strategies. The propeller noise is characterized by a significant low-frequency component, and

reductions in aircraft-interior noise can be achieved by selecting a blade-pass frequency that is far from the fifth and seventh modes of the system. Synchrophasing - the selective excitation of propeller modes - permit the use of the relative phase between the two modes to reduce interior noise without introducing a weight penalty. C.C.S.

A92-39084

A SURVEY OF ACTIVE CONTROL IN AIRCRAFT CABINS

G. P. EATWELL (NCT /UK/, Ltd., St. John's Innovation Centre, Cambridge, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 817-820.

Copyright

Active noise-control techniques for the aircraft environment are reviewed including headsets, local zone cancellation, and distributed control. By examining such system parameters as weight, required power, attenuation, and controller inputs and outputs, the headset noise-cancellation system appears to be the most efficient solution. However, the use of a global system is argued to be more convenient and, when combined with zonal control for passengers, as efficient as a headset system. C.C.S.

A92-39087

PROPELLER SOUND EXCITATION ON AN AIRCRAFT FUSELAGE USING A LOUDSPEAKER RING

LARS GUSTAVSSON and BENGT SIMONSSON (Aeronautical Research Institute of Sweden, Bromma) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 829-832. refs

Copyright

A system is developed for simulating and exciting aircraft propeller fields is introduced that facilitates the characterization of interior noise in propeller aircraft. A ring of loudspeaker enclosures is mounted on a test aircraft and an acoustic mock-up of a propeller aircraft, and the system systematically varies the excitations by means of blade-passage frequency and synchrophasing. The method is shown to be of use in the evaluation of noise-control treatment without requiring measurements from several flights. C.C.S.

A92-39089

NOISE INSIDE AIRCRAFT FUSELAGES SUBJECTED TO AIRBORNE EXCITATION

M. GOULAIN (Aerospatiale, Toulouse, France) and C. LESUEUR (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 837-842. Previously announced in STAR as N91-23853. refs

Copyright

Noises inside a cockpit and a cabin and airborne and structureborne noise are summarized with the use of graphics. The necessity of having a model of acoustic and vibration transmission is outlined. The history and complexity of models, fuselage test in laboratory and a comparison of theory and experiment are discussed. The modal method is concluded to give a good understanding of the transmission phenomena through an aircraft fuselage in a 0.15 to 2.3 frequency range. The ease of use of these methods allow parametrical studies for preliminary design for noise reduction purpose. Author

A92-39304

AIRCRAFT STRUCTURAL DESIGN

F. W. VANN (British Aerospace, PLC, Hatfield, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 6B.1-6B.10.

Copyright

The complex and often conflicting requirements for the design of a successful civil aircraft are presented. Every additional pound of weight to any item that improves the attractiveness of the aircraft to the customer means an increase in the gross weight of the aircraft, thus necessitating increased take-off and landing distance and higher fuel consumption during cruise. The need to carry more fuel in itself increases the operating weight of the aircraft and further complicates selection of the best compromise. Therefore, the designer's primary task must be to reduce the weight of the aircraft to the absolute minimum. R.E.P.

A92-40009

CONCORDE FLIGHT TESTING - POWERPLANT AND PERFORMANCE FLYING

E. B. TRUBSHAW (British Aerospace, PLC, London, England) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991, 15 p.

(SAE PAPER 912192) Copyright

Concorde, the first major civil airliner project conducted on a collaborative basis, employed two assembly lines and two flight-test centers; the flight test program allocated the main tasks to each of the initial developmental aircraft. Attention is presently given to milestones and lessons associated with the powerplant test and performance flight test programs, encompassing the air-intake control system, engine inlet surges, aircraft response to atmospheric disturbances, deicing trials, and performance monitoring during takeoff, cruise, and landing. O.C.

A92-40030

JAS 39 GRIPEN FLIGHT TEST REPORT

PER PELLEBERGS and ARNE LINDHOLM (Saab-Scania, AB, Aircraft Div., Linkoping, Sweden) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 16-26.

Copyright

A review is presented of the current status of the JAS 39 Gripen flight test program and some of the project's milestones in the development of this aircraft. Attention is given to the Gripen operational concept and a comparison with the JAS 37 Viggen that it is slated to replace. Consideration is given to the flight envelope, the aerodynamics, general flying characteristics, and the engine with afterburner. R.E.P.

A92-40035

RAFALE: PROGRAM UPDATE - DEVELOPMENT OF A NAVAL VERSION

YVES KERHERVE (Dassault Aviation, Vaucresson, France) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 104-117.

Copyright

A program overview is presented of the development of a naval aircraft carrier version of the French Rafale fighter, which is to be operational and carrier-embarked in 1996. Demonstrator tests are described that include field carrier landing and carrier approach techniques. General handling qualities, flight performance, and design modifications are described. Attention is given to the Rafale's shore-based carrier suitability tests, which are to be conducted at the unique facilities of Lakehurst and Patuxent in the U.S. R.E.P.

A92-45311

EVOLUTION OF ASTOVL AIRCRAFT DESIGN

J. T. PLATT, K. AINSWORTH, and G. STOTT (British Aerospace /Military Aircraft/, Ltd., Preston, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. II.10.1-II.10.1.14.

Copyright

Attention is given to the evolution of an ASTOVL vehicle with Harrier-like powered lift operation which satisfies the requirement of combining the STOVL advantages into a single viable engine

airframe configuration without compromising operational effectiveness. This is achieved by incorporating a novel Rolls Royce engine design which provides low specific thrust for benign operations during powered lift and high specific thrust for conventional agile supersonic flight. The configuration drivers and design compromises are identified and discussed. STOVL and CTOL aircraft configurations with and without powered-lift constraints are illustrated. C.A.B.

A92-45315 **CONFIGURATION EFFECTS ON THE INGESTION OF HOT GAS INTO THE ENGINE INTAKE**

P. G. KNOTT (British Aerospace /Military Aircraft/, Ltd., Preston, England) and C. M. MILFORD (British Aerospace /Military Aircraft/, Ltd., Kingston-upon-Thames, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.3.1-III.3.13. refs Copyright

The ingestion of hot engine exhaust gas into the engine air intakes of combat aircraft which use jet lift to enable the aircraft to perform V/STOL is discussed. The effect of configuration variables on hot gas ingestion (HGI), with respect to the intake air temperature rise dependence in space and time, is discussed. It is concluded that development of the Harrier family should use low-temperature fan air front jets in vertical operation in ground effect. The HGI level can then be controlled by the use of CADs and modest splay angles. Side-by-side two-poster jet lift systems are proposed. It is concluded that it is very difficult to achieve low levels of HGI with this arrangement. C.A.B.

A92-45491# **TWO-POINT OPTIMIZATION OF COMPLETE THREE-DIMENSIONAL AIRPLANE CONFIGURATION**

K. KUBRYNSKI (Warsaw, Technical University, Poland) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 172-180. refs (AIAA PAPER 92-2618) Copyright

A subcritical panel method applied to flow analysis and aerodynamic multipoint design of complex aircraft configurations is presented. The analysis method is based on linearized, compressible, subsonic flow equations and indirect Dirichlet boundary conditions. Quadratic doublet and linear source distribution on flat panels are applied. In the case of aerodynamic design the geometry which minimizes discrepancy between target and actual pressure distributions on different parts of configuration at different angles of attack is found iteratively using numerical optimization technique. Geometry modifications are modeled by surface transpiration. Constraints in respect to resulting geometry can be specified. Examples of 3D design are presented. The software is adopted to personal computers, and as a result an unexpected low cost of computations is obtained. Author

A92-46806 **OPTIMUM CRUISE LIFT COEFFICIENT IN INITIAL DESIGN OF JET AIRCRAFT**

RODRIGO MARTINEZ-VAL and EMILIO PEREZ (Madrid, Universidad Politecnica, Spain) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 4, July-Aug. 1992, p. 712-714. refs Copyright

An attempt is made to develop a more realistic model of the optimum cruise of a jet aircraft by considering the effect of the Mach number on the specific fuel consumption. It is assumed that the specific fuel consumption is influenced by the Mach number in accordance with a potential law, which, along with the constant altitude constraint, allows a simple analytical treatment of the range equation and related expressions. The final results are written in closed form. An application of the results to performance prediction is illustrated. V.L.

A92-47969 **A340 HANDLING, COCKPIT DESIGN IMPROVE ON PREDECESSOR A320**

DAVID M. NORTH Aviation Week and Space Technology (ISSN 0005-2175), vol. 137, no. 2, July 13, 1992, p. 38-41, 44, 45. Copyright

A92-47975 **US NAVY REVISITS ESCAPE MODULES**

JOHN KELLER Interavia Aerospace Review (ISSN 0020-6512), vol. 47, July 1992, p. 28-30. Copyright

U.S. Navy scientists are researching a technology that has been considered in the past, to develop several high-speed and high-altitude aircraft escape modules, in which the pilot remains strapped in and the jettisoned self-contained module parachutes to the ground. One option under consideration would transform the cockpit after separation into a tiny aircraft, thus allowing combat pilots to fly to safe areas for rapid and easy rescue. The work in this research area of the Naval Air Warfare Center, and several civilian aircraft manufacturers is reviewed. R.E.P.

A92-48586 **THE A320 LAMINAR FIN PROGRAMME**

J. J. THIBERT (ONERA, Chatillon, France), A. QUAST (DLR, Braunschweig, Federal Republic of Germany), and J. P. ROBERT (Airbus Industrie, Toulouse, France) (European Forum on Laminar Flow Technology, 1st, Hamburg, Federal Republic of Germany, Mar. 16-18, 1992) ONERA, TP no. 1992-23, 1992, 8 p. (ONERA, TP NO. 1992-23)

A review is presented of ongoing research into hybrid laminar flow as a drag reduction technique for the next generation of transport aircraft. The wind tunnel model, its equipment and the suction device are described. Results concerning the aerodynamic aspects and current progress of the program are presented. R.E.P.

A92-48589 **RESEARCH ON HELICOPTER ROTORS - PROGRESS IN AERODYNAMICS, AEROELASTICITY AND ACOUSTICS [RECHERCHES SUR LES ROTORS D'HELICOPTERES - PROGRES EN AERODYNAMIQUE, AEROELASTICITE ET ACOUSTIQUE DES ROTORS D'HELICOPTERES]**

JEAN-JACQUES PHILIPPE (ONERA, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 152, 1992, p. 13-17) ONERA, TP no. 1992-27, 1992, 6 p. In French. refs (ONERA, TP NO. 1992-27) Copyright

Several research and development improvements on helicopter rotors accomplished over the past 20 years at ONERA are reviewed. Continuing studies focusing on new rotor concepts to assure a better compromise between aerodynamic performance, vibration levels, and rotor noise are described. Attention is given to the aerodynamics of rotors, the aeroelasticity of rotor blades, and the various areas of external noise generation. R.E.P.

A92-50009 **BRITISH AEROSPACE HAWK INTO THE 1990S**

G. CHISNALL (British Aerospace /Military Aircraft/, Ltd., North Humberside, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 206, no. G1, 1992, p. 27-36. Copyright

The paper covers a review of the British Aerospace Hawk aircraft program. An overview of the main development events and entry into RAF service is included, which emphasizes the versatility of the basic concept. This was deliberately designed in by the original team in order to maximize the subsequent export potential of the aircraft. That this was an outstanding success is shown in the outline of the main export variants to date. This background gives context to the main body of the paper, in which the new Hawk aircraft developments, the 100 and 200 series, respectively, are described. These advanced versions are intended to maintain the market dominance of Hawk throughout the 1990s and beyond. A final, brief review of the broader environment within which BAe is carrying out its private venture development of Hawk is included as a conclusion to the paper. Author

A92-51580

BA'S 777

J. M. RAMSDEN Aerospace (UK) (ISSN 0305-0831), vol. 19, no. 7, July 1992, p. 12-18.

Copyright

An overview is presented of the Boeing-British Airways coordinated design, development and operational aspects of the newly ordered 777 aircraft. Attention is given to the performance summary of the initial 777 and its stretch version based on typical mission rules. Consideration is given to the engineering team structure and function, which organization is based both in London and Seattle. R.E.P.

A92-51947

EFFECT OF A DEICING DEVICE ON THE INDUCED DRAG OF A LIFTING AIRFOIL [VLIV PORUCHY ODMRAZOVACIHO ZARIZENI NA INDUKOVANY ODPOR NOSNE PLOCHY]

ZDENEK SKODA Zpravodaj VZLU (ISSN 0044-5355), no. 1, 1992, p. 5-7. In Czech. refs

Copyright

In the reliability analysis of an aircraft deicing system, it is essential that consideration be given to the possible consequences of the partial failure of the deicing system on aircraft maneuverability and controllability. Here, a method for evaluating the effect of deicing failures on the induced drag is presented. V.L.

A92-52300

777 SHAPING UP

GUY NORRIS and GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 142, no. 4325, July 1, 1992, p. 27, 28, 30-32.

Copyright

An overview is presented of the assembly of the 777 transport with parts from more than a dozen countries, over 40 major suppliers, subcontractors, and hundreds of smaller suppliers as product definition takes place. Attention is given to the systems integration laboratory that will house a dedicated 777 flight-control test rig now being built, complete with control surfaces, full electronics, electrical power system and some parts of the hydraulics. Consideration is given to the powerplants, computer design system, the advanced air conditioning system, avionics and landing gear wheels, brakes and tires. R.E.P.

A92-52849

THE APPLICATION OF A THEORETICAL BLADE SAILING MODEL TO PREDICT THE BEHAVIOUR OF ARTICULATED HELICOPTER ROTORS

S. J. NEWMAN (Southampton, University, United Kingdom) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 956, June-July 1992, p. 233-239. Research supported by Ministry of Defence Procurement Executive.

Copyright

A theoretical model had been previously developed to predict the behavior of a semi-rigid helicopter rotor blade during rotor engagement and disengagement under high wind conditions. This has now been extended to cater for an articulated rotor by modeling the droop and anti-flap stop mechanisms by high rate linear springs. Much increased blade deflections are predicted, as anticipated, along with the possibility of blade tip/tail boom contact at a high enough wind speed. The importance of the higher modes in the description of the phenomenon is demonstrated. A comparison of the theoretical model with an experiment using a full size Puma aircraft is presented. Author

A92-53121

REGIONAL CHALLENGE

HARRY HOPKINS Flight International (ISSN 0015-3710), vol. 142, no. 4333, Aug. 26-Sept. 1, 1992, p. 39-42.

Copyright

The Regional Jet developed in Canada is described and discussed in terms of unique design features, flying issues for pilots, and the its performance in a test flight. Specific details are given regarding the aircraft's ability to hold high power, and the wing design is shown to afford compensation for the relatively

heavy aircraft. The Regional Jet is shown to have high system redundancy and good fuel burn, and the maneuverable aircraft is expected to be an effective carrier for short flights. C.C.S.

A92-54545

RAPIDLY GOING NOWHERE?

ROY BRAYBROOK Air International (ISSN 0306-5634), vol. 43, no. 2, Aug. 1992, p. 67-73.

Copyright

An overview is presented of frontline combat aircraft of the former USSR recently displayed at Minsk that demonstrate the latest military aviation developments. Attention is focussed on the SU-25 TK, an improved attack version of the basic Frogfoot A. Consideration is given to the Mig-29, SU-27, MiG-31M, and various missiles now listed as available for export sales. R.E.P.

A92-56285*

National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

THE COMPUTATION AND VALIDATION OF HOVERING ROTOR PERFORMANCE

M. N. MBA (Marseille, Institut de Mecanique des Fluides, France), K. RAMACHANDRAN (NASA, Ames Research Center, Moffett Field, CA), and F. X. CARADONNA (U.S. Army, Aviation Systems Command; NASA, Ames Research Center, Moffett Field, CA) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 16 p. refs

(Contract DRET-89-1433-DS-SR)

Recent experience with the HELIX-I code is presented, and its ability to predict the flow and performance of both conventional rotors and the unconventional anhedral parabolic tip rotor utilized on the Super Puma MK2 is described. HELIX-I is a standard full-potential rotor code having the ability to efficiently predict the detailed flow on a rotor blade, including 3D, transonic, and weak viscous effects (using appropriate boundary layer analyses). The resulting code is the first full-potential CFD code with the ability to model free wake convection and the first CFD code of any type to predict hover performance. R.E.P.

A92-56287

SIMULATION OF HELICOPTER SEE-SAW ROTOR MOTION

JANUSZ NARKIEWICZ and WIESLAW LUCJANEK (Warsaw University of Technology, Poland) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 12 p. refs

Consideration is given to a model developed to simulate the motion of a helicopter see-saw rotor which consists of two elastic blades attached to the deformable shaft with pitch and skew flap hinges. The deformable blades can bend in two perpendicular directions and twist around the straight elastic axis. Aerodynamic loads are calculated on the basis of nonlinear steady 2D airfoil data. The unsteady flow effects are described by the dynamic inflow model. The equations of motion are generated from Hamilton's principle in a semiautomatic manner with most of the algebraic manipulations done by computer. The blade deflections are discretized by free vibration modes calculated for rotating blades. The model can be incorporated into computer software for numerical integration and stability analysis. C.A.B.

A92-56302

SHORT TAKEOFF OPTIMIZATION FOR THE XV-15 TILTROTOR AIRCRAFT

T. M. CERBE (Deutsche Lufthansa AG, Hamburg, Germany), G. REICHERT (Braunschweig, Technische Universitaet, Germany), and D. P. SCHRAGE (Georgia Institute of Technology, Atlanta) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 20 p. Research supported by DFG. refs

The short takeoff capability of a civil tilt-rotor aircraft XV-15 is investigated by analyzing the effects of gross weight, ambient conditions, the power available, the flap setting, the nacelle tilt, and the maneuver strategy on the takeoff-related performance. It was found that a takeoff with a nacelle angle of about 20 deg and a flap deflection of 40 deg yields the shortest takeoff distance. It is noted that the calculated performance of the generic tilt rotor simulation (GTRS) used in this analysis might not accurately

represent the XV-15 performance in the low-speed forward flight regime, and that further improvements of GTRS for this flight regime are required. I.S.

A92-56307

LYNX - A 50 YEAR PRODUCT?

J. C. BARKER (Westland Helicopters, Ltd., Yeovil, United Kingdom) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 9 p.

The last two decades of continued development of the Lynx helicopter are reviewed to demonstrate the helicopter performance and the benefits of continued modifications in aircraft. Among the key upgrades examined are those for the: undercarriage, sonar, tail, bag flotation, tail rotor, nose, general structure, and the IR and radar sensor systems. The changes are grouped into two enhancement steps with significant benefits that are listed in the areas of total weight, V_{no}, maximum hover height, and maximum continuous power. The results demonstrate the value of continuous upgrading processes in uprating the potential of aircraft as well as providing additional mission capabilities. Additional upgrading is expected for the Lynx helicopter which boasts several decades of utility in helicopter applications. C.C.S.

A92-56330

CURRENT EUROPEAN RESEARCH ACTIVITIES IN HELICOPTER INTERACTIONAL AERODYNAMICS

G. PAGNANO and A. SAPORITI (Agusta S.p.A., Cascina Costa di Samarate, Italy) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 20 p. Research supported by EEC. refs

The status of a Study and Computation of Interactional Aerodynamics (SCIA), an European collaborative program for interactional aerodynamics of helicopter configuration which was started in 1990, is discussed. The SCIA project is aimed at improving existing methodologies for helicopter components and developing algorithms for predicting the complex rotor/fuselage interaction. Particular attention is given to the activities in the experimental and computational fields for both the isolated and complete configurations. O.G.

A92-56340

DEVELOPMENT OF A CONCEPTUAL DESIGN METHOD FOR ROTARY-WING AIRCRAFT USING DIGITAL COMPUTERS

D. PALASIS and S. WAGNER (Muenchen, Universitaet der Bundeswehr, Neubiberg, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 14 p. refs (Contract BMVG-T/RF41/I0008/I1407)

Presented in this paper is the development of a conceptual design method for rotary-wing aircraft. This method allows to perform conceptual design studies for a helicopter or tiltrotor based on a given mission and with the help of Carpet-Plots. The corresponding computer program, which has a modular structure, contains a number of subroutines, where the most important ones are those to stimulate the engine behavior including fuel consumption, to calculate the weight break-down and to compute aerodynamic forces, performance and trim. The variation of some geometric parameters is presented for a light helicopter and a tiltrotor. The comparisons of the optimized data for the light helicopter and the tiltrotor show good agreement with those for some designed aircraft. Author

A92-56342

THE ACHIEVEMENT OF AERODYNAMIC GOALS ON THE EH101 PROJECT THROUGH THE 'SINGLE SITE' CONCEPT

C. MAZZUCHELLI (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Milan, Italy) and F. T. WILSON (Westland Helicopters, Ltd., Yeovil, United Kingdom) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 10 p. refs

An EH101 helicopter project based on a single site concept and developed by a collaborative effort of Agusta and Westland companies is described. A systematic approach to key aerodynamic related issues including shuffle, pitch up, and performance is considered, using scale model testing in the wind tunnels of both

companies in conjunction with CFD and simulation codes followed by confirmatory flight tests. The aerodynamic development program is aimed at optimizing the aircraft as an integrated machine with the main and tail rotors, air frame, and engines working effectively together throughout the flight envelope. O.G.

A92-56343

AS 332 MKII - DEVELOPMENT AND CERTIFICATION

J. P. DEDIEU and A. FLEISCHMANN (Aerospatiale, Division Helicoptere, Marignane, France) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 12 p.

The development and certification processes of the Super Puma AS MKII helicopter are examined. It is pointed out that, compared with its predecessor, AS 332 MKI, the aircraft definition of the AS 332 MKII is 80 percent new or is modified, especially in the areas of rotors and transmissions, the avionics, and the electrical power system. The modifications introduced were intended to set new standards for this category of helicopters in terms of safety, maintenance, and passenger and crew comfort. Diagrams of new AS 332 MKII structures are presented. I.S.

A92-56350

CORRELATION OF FLIGHT, TUNNEL AND PREDICTION DATA ON A HELICOPTER MAIN ROTOR

G. PAGNANO, F. NANNONI, M. SIMONI (Agusta S.p.A., Cascina Costa di Samarate, Italy), and H. J. LANGER (DLR, Braunschweig, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 23 p. refs

Results are presented of a detailed analysis performed on the available data of the wind tunnel testing carried out on an isolated articulated four-bladed main rotor model. The correlation with prediction methods and flight test data is discussed in terms of global data, i.e., power level, rotor forces, control angles, and control loads. Different prediction methods ranging from energy methods and a simplified trim algorithm to a blade element code are applied. The codes are described in terms of characteristics, input data and solution procedures, and the level of confidence already gained with flight test data comparison. The effects of a number of simulation parameters, both in calculation methods and wind tunneling modeling, such as the blade dynamics representation and the rotor system configuration, are discussed. The level of confidence achieved in tunnel simulation and model testing, and in the prediction of rotor characteristics is presented. C.A.B.

A92-56809#

COMPARISON OF RECENT RESULTS FROM DIFFERENT WIND TUNNEL FACILITIES ALONG WITH COMPARISONS OF MEASURED FLIGHT RESULTS AND WIND TUNNEL BASED PREDICTIONS

KEITH PALLISTER (Aircraft Research Association, Ltd., Bedford, United Kingdom), JON PARKER (British Aerospace Airbus, Ltd., Filton, United Kingdom), and BRIAN PROBERT (British Aerospace Defence, Ltd., Warton, United Kingdom) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 22 p. Research supported by Ministry of Defence Procurement Executive. refs

(AIAA PAPER 92-3985) Copyright

Data are presented covering three areas associated with wind tunnel facilities and the prediction and verification of flight vehicle characteristics. Initially, wind tunnel data obtained from two different UK facilities are compared. Secondly, the method used by British Aerospace Airbus Ltd to predict aircraft performance from wind tunnel data is outlined along with the presentation of results for the A310 Airbus. Finally, loading data obtained both in the wind tunnel and flight are compared for the EAP fighter configuration. Author

N92-11001# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanic's Panel.

ROTORCRAFT SYSTEM IDENTIFICATION

Sep. 1991 291 p

(AGARD-AR-280; ISBN-92-835-0632-4; AD-A244250) Copyright
 Avail: CASI HC A13/MF A03

For fixed wing aircraft, system identification methods to determine stability and control derivatives from flight test data are used with confidence. The application of the same techniques to rotorcraft is not so far advanced mainly because of the helicopter aeromechanical complexity. Only a few specialists have concentrated on this field and the application in industry is still sporadic. To coordinate these activities within the AGARD nations, a working group was constituted to focus on the applicational aspects of the various individual approaches and to evaluate the strengths and weaknesses of the different methods. The findings are presented of the Working Group including a documentation of the data bases, the applied identification methodologies, and major application areas. For each of the three helicopters, comparisons of the obtained results are discussed in the format of case studies, covering data quality evaluations, identification, and the verification of the obtained models. Author

N92-11009# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique.

WING TIP TURBINE: ANALYSIS OF THE RESULTS OF S2MA SOUNDING OF MARGINAL VORTEX OF THE A320, TECHNICAL SUMMARY [TURBINE DE BOUT D'AILE: ANALYSE DES RESULTATS DES SONDAGES A S2MA DU TOURBILLON MARGINAL DE L'A320. RAPPORT TECHNIQUE DE SYNTHESE]

F. MANIE Nov. 1990 34 p In FRENCH

(Contract STPA-85-95-009)

(ONERA-RTS-21/4365-AY-056A; ETN-91-90082) Avail: CASI HC A03/MF A01

Tests (force, pressure, sounding) were carried out at the S2MA wind tunnel for flight conditions of A320 transonic crossing on the 4A.2 model at 1:16.5. The device has six degrees of freedom equipped with a pressure sensor of five holes. Six lower airfoils of free wing extremity were investigated to define the flow structure neighboring the marginal vortex. The results were analyzed to determine the entry conditions for defining the vanes and the positioning of a wing tip turbine, a device intended to reduce the induced drag or to produce a power injection for transport aircraft. ESA

N92-11993# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

PERFORMANCE IMPROVEMENTS AND FUEL COST SAVINGS DUE TO LEADING EDGE MODIFICATION OF A VINTAGE DELTA WING JET FIGHTER

SVEN-OLOF RIDDER Apr. 1991 29 p Original contains color illustrations

(Contract FMV-FFL-82260-89-262-73-001)

(FFA-TN-1991-22; ETN-91-90287) Avail: CASI HC A03/MF A01

The improved aerodynamic efficiency of the aircraft J35 Draken resulting from simple leading edge modifications is evaluated. The study was carried out using earlier wind tunnel data and the actual data of installed thrust and fuel consumption of the jet engine. Improvements in important performance aspects comparable to what could have been achieved by installing a modern jet engine, but at a fraction (probably less than 5 pct.) of the cost switching to a new engine as achieved. A significant improvement in pitch and roll stability in relation to the characteristics of the original aircraft was also achieved. Apart from the obvious tactical value of upgrading the performance (range, maneuver and external load) there comes the added peacetime benefit of a 25 pct. fuel cost reduction for a given training program. ESA

N92-13929*# National Aerospace Lab., Amsterdam (Netherlands).

REVIEW OF AERODYNAMIC DESIGN IN THE NETHERLANDS

TH. E. LABRUJERE In Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 1-30 1991

Avail: CASI HC A03/MF A06

Aerodynamic design activities in the Netherlands, which take place mainly at Fokker, the National Aerospace Laboratory (NLR), and Delft University of Technology (TUD), are discussed. The survey concentrates on the development of the Fokker 100 wing, glider design at TUD, and research at NLR in the field of aerodynamic design. Results are shown to illustrate these activities. Author

N92-13948*# Warsaw Technical Univ. (Poland). Inst. of Applied Mechanics and Aviation Technology.

DESIGN OF 3-DIMENSIONAL COMPLEX AIRPLANE CONFIGURATIONS WITH SPECIFIED PRESSURE DISTRIBUTION VIA OPTIMIZATION

KRZYSZTOF KUBRYNSKI In Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 263-280 1991

Avail: CASI HC A03/MF A06

A subcritical panel method applied to flow analysis and aerodynamic design of complex aircraft configurations is presented. The analysis method is based on linearized, compressible, subsonic flow equations and indirect Dirichlet boundary conditions. Quadratic dipole and linear source distribution on flat panels are applied. In the case of aerodynamic design, the geometry which minimizes differences between design and actual pressure distribution is found iteratively, using numerical optimization technique. Geometry modifications are modeled by surface transpiration concept. Constraints in respect to resulting geometry can be specified. A number of complex 3-dimensional design examples are presented. The software is adopted to personal computers, and as result an unexpected low cost of computations is obtained. Author

N92-13949*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. of Theoretical Fluid Mechanics.

EXTENDED MAPPING AND CHARACTERISTICS TECHNIQUES FOR INVERSE AERODYNAMIC DESIGN

H. SOBIECZKY and Y. J. QIAN In Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 281-292 1991

Avail: CASI HC A03/MF A06

Some ideas for using hodograph theory, mapping techniques and methods of characteristics to formulate typical aerodynamic design boundary value problems are developed. The inverse method of characteristics is shown to be a fast tool for design of transonic flow elements as well as supersonic flows with given shock waves. Author

N92-14042# Centre d'Essais Aeronautique Toulouse (France). Lab. des Matériaux Metalliques.

MECHANICAL QUALIFICATION TESTS FOR MATERIALS USED IN THE FABRICATION OF AIRCRAFT PARTS [ESSAIS MECANQUES ENTRANT DANS LE CADRE DE LA QUALIFICATION DE MATERIAUX POUR LA REALISATION DE PIECES (AVION). PROCES-VERBAL DE L'ESSAI M5-5443/01]

J. C. FAURE 12 Jun. 1991 64 p In FRENCH (CEAT-M5-5443/01; ETN-92-99978) Avail: CASI HC A04/MF A01

The mechanical tests performed to qualify several materials applied in aircraft components are described. The aim of the study is to define the rules concerning the principles of the tests and how to structure the results to be presented. The preparation of the sample, the test parameters and the analysis of the results are also defined. The tests were performed on light alloys, steels, titanium alloys and refractory alloys. The mechanical properties of the materials were evaluated by tests involving: resilience, strain, toughness, crack propagation and fatigue. The results of the mechanical tests are not included. ESA

N92-14045# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

BULGING OF FATIGUE CRACKS IN A PRESSURIZED AIRCRAFT FUSELAGE

D. CHEN and J. SCHIJVE May 1991 41 p Presented at the 16th ICAF Symposium, Tokyo, Japan, 22-24 May 1991 (LR-655; ETN-92-90420; PB92-133438) Avail: CASI HC A03/MF A01

Fatigue crack growth and residual strength must be considered as part of the damage problem of a pressurized aircraft fuselage. Longitudinal cracks offer problems because they occur in a curved thin sheet structure under biaxial loading conditions and internal pressure. The fatigue crack edges bulge outwards (out of plane deformation) which considerably complicates the fracture mechanics analysis. The problem is analyzed empirically and theoretically. Three test set ups were developed respectively for sheet specimens with a large radius of curvature loaded by internal air pressure and hoop stress. Fatigue crack growth and residual strength tests were carried out on aluminum alloy sheet specimens and some panels of new metal sheet/fiber laminates (Aramid Reinforced Aluminum Laminate (ARALL) and GLARE). Analytical relations were developed to obtain K values, which account for the nonlinear behavior associated with sheet curvature and bulging out of the crack edges. The predictions agree with the present test results, and with results from the literature obtained by finite element method calculations for fuselages and in full scale fatigue tests. ESA

N92-15065# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

MONITORING LOAD EXPERIENCE OF INDIVIDUAL AIRCRAFT

J. B. DEJONGE 3 Sep. 1990 12 p Presented at 17th ICAS Congress, Stockholm, Sweden, Sep. 1990 (NLR-TP-90084-U; ETN-92-90432; AD-B156440L; PB92-138643) Avail: CASI HC A03/MF A01

The actual service load experience of aircraft may differ appreciably from design assumptions. The necessity to monitor service loads is generally recognized now for military aircraft. A general review of the overall life management procedure commonly used today is given. Specific elements in this procedure are discussed in some detail. Specific attention is paid to the amount of scatter in severity between different flights and the required sample sizes of flight load measurements for obtaining reliable average load spectrum data. Possible causes for variation in load experience between different aircraft flying the same duty are analyzed. It is concluded that Individual Aircraft Tracking (IAT), if necessary at all, can usually be adequately accomplished by administrative means, indicated as Usage Monitoring. ESA

N92-15987 ESDU International Ltd., London (England).

ENERGY HEIGHT METHOD FOR FLIGHT PATH OPTIMISATION. ADDENDUM A: NUMERICAL METHOD SUITABLE FOR RAPID USE ON IBM PC COMPATIBLE COMPUTERS

Sep. 1991 10 p (ISSN 0141-4054) (ESDU-91016-ADD; ISBN-0-85679-778-2) Avail: ESDU

A method is suggested of speeding up the calculation of the optimum flight path by the energy height method of ESDU 90012. Although programming the graphical methods used is possible, it is quicker to apply a simple linear search routine to seek minimum df/dH sub e (where f is the parameter to be minimized, e.g., time or fuel, and H sub e is energy height) along contours of constant energy height. A feasible flight envelope for the search is first established (taking account of, e.g., maximum design speed and altitude, buffet boundary, the requirement that thrust must exceed drag, etc). Then a choice of initial velocity increment is made to establish the region of the minimum and the increment is then progressively reduced as smaller and smaller regions are searched to locate the minimum with a required accuracy. The use of linear search technique is only necessary because two minima may exist; if it is known there is only one minimum, the use of a Fibonacci search routine is recommended and explained. The method is

illustrated using the worked examples in ESDU 90012; one is minimum time to a given speed and height for a supersonic combat aircraft and the other is minimum fuel to a given speed and height for a subsonic transport aircraft. ESDU

N92-15988 ESDU International Ltd., London (England).

ESTIMATION OF AIRBORNE PERFORMANCE IN LANDING

Oct. 1991 46 p Supersedes ESDU-Perf-EG6/3 (ISSN 0141-4054) (ESDU-91032; ESDU-PERF-EG6/3; ISBN-0-85679-793-6) Avail: Issuing Activity

Methods for estimating airborne distance for fixed-wing aircraft are given. The time taken is estimated as a function of the change in rate of sink between the screen and touch-down using a correlation developed from measured data for landings without significant float. This is directed towards certification style landings of transport aircraft, but some guidance is given for cases with significant float as well. A further empirical correlation allows an independent assessment of the time taken and of the speed loss during the maneuver to be made from the energy equation; the correlation provides the average value of drag minus thrust, again depending on whether there is a significant float or not. The ranges of aircraft types and flight conditions for which data were available are tabulated and cover a wide range of weights, geometry, approach angles and powerplants (turbo-jet, turbo-fan and turbo-prop). The correction of still air distance for the effect of wind and wind gradient is discussed. The geometric relationships that result if the path is prescribed to be some combination of circular arc and straight-line segments are given. Three worked examples illustrate the use of the method to determine the distance. ESDU

N92-17313# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

AERODYNAMIC DEVELOPMENT OF THE X-31 AIRCRAFT FOR THE HIGH ANGLE OF ATTACK REGION

WERNER KRAUS May 1991 38 p (MBB-FE211-S-PUB-452; ETN-92-90620) Copyright Avail: CASI HC A03/MF A01

The X-31 high agility airplane is designed to operate well at high angles of attack. The aircraft is designed to have natural aerodynamic stability about all three axes in the entire angle of attack range, except at small angles of attack, where the aircraft is unstable in pitch for performance reasons. In critical regions in which natural stability cannot be contained, the control power required to achieve stability is provided to the appropriate axis by artificial control, still leaving sufficient control for power maneuvers. The results of the wind tunnel development program are presented. Additional wind tunnel tests in a spin tunnel are presented. ESA

N92-17847 ESDU International Ltd., London (England).

VARIABILITY OF STANDARD AIRCRAFT PERFORMANCE PARAMETERS

Oct. 1991 8 p (ISSN 0141-4054) (ESDU-91020; ISBN-0-85679-782-0) Avail: ESDU

This data item presents data on the variability of civil aircraft and engine performance quantities drawn from a report of the ICAO Standing Committee on Performance, and also more recent information on the variability of turbo-fan engine performance quantities. These latter data are given as ranges of uncertainty and are converted to the ICAO form of a standard deviation using information from ESDU 91017. The variability data are then used to calculate the variability of takeoff climb gradient. The methods of ESDU 91017 are again used, this time to calculate the overall variability arising from the cumulative effects of the individual variabilities in drag, thrust, and weight. ESDU

N92-18096 ESDU International Ltd., London (England).

STATISTICAL METHODS APPLICABLE TO ANALYSIS OF AIRCRAFT PERFORMANCE DATA

Oct. 1991 34 p

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

(ISSN 0141-4054)

(ESDU-91017; ISBN-0-85679-779-0) Avail: ESDU

A flowchart is used to guide its user in the application of statistical techniques to the analysis of performance data from which all but random variability has been removed; that is, they have been reduced to standard conditions. The possibility of combining small samples in a larger sample, so improving the accuracy of predictions, is considered. Fisher's Variance Ratio F test is used to decide with a certain confidence whether the samples are from the same population, and Student's t test determines the significance between sample means. Larger samples, exceeding 30 points, either from combined smaller samples or as measured, are treated using Normal distribution statistics provided the Chi squared test for normality with a chosen confidence is met. If the test fails, a transformation of the data (for example, taking the logarithm) may provide a Normal distribution. The use of probability graph paper as a means of analyzing data to the Normal distribution is explained. Regression is considered because, although not a statistical technique, the results are analyzed statistically. The manual calculation of linear two variable regression is discussed, and determination of variance about the regression line, the significance of the regression relationship, regression confidence intervals, and the correlation coefficient and its significance are treated. Multiple linear regression is briefly considered. Tables present the statistics of the Normal distribution, Student's t distribution, the Chi squared distribution and the F distribution. Examples on the use of the methods are found in ESDU 91018 to 91020. ESDU

N92-18333# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

DESIGN, ANALYSIS, AND TESTING OF INTEGRALLY STIFFENED COMPOSITE CENTRE FUSELAGE SKIN FOR FUTURE FIGHTER AIRCRAFT

L. LEMMER and H. LONSINGER 3 May 1991 21 p Presented at the 8th International Conference on Composite Materials, Honolulu, HI, 15-19 Jul. 1991 (MBB-FE2-PUB-S-450; ETN-92-90614) Copyright Avail: CASI HC A03/MF A01

A center fuselage skin made of one piece carbon fiber composite monocoque with double curvature, stiffened with simultaneous curved frames and longerons, is described. The basic design, material selection and stressing of typical features are discussed and compared with test results. The design is assessed in terms of weight reduction and production cost considerations. ESA

N92-18574# Veritas Research A.S., Hovik (Norway). PROBABILISTIC DESIGN AND FATIGUE MANAGEMENT BASED ON PROBABILISTIC FATIGUE MODELS WITH RELIABILITY UPDATING

R. SKJONG, G. SIGURDSSON, and M. K. NYGARD In AGARD, Fatigue Management 7 p Dec. 1991 Copyright Avail: CASI HC A02/MF A03

The fatigue limit state is the governing limit state for an aging airframe. The trend of operating aircraft longer than their originally planned life, calls for extensive testing and inspection. Current practice is to base decisions with respect to inspections and repair on the durability and damage tolerance methodologies. These procedures make little use of probabilistic methods. The paper addresses the same basic problems of similar fundamental models. The formulations are, however, casted into a probabilistic format. In particular the possibility of incorporating new inservice information, based on inspection results or load measurements, is discussed and demonstrated. The advantage of this formulation is illustrated by some examples. Some comments are about future research that would be necessary to fully utilize the capabilities of probabilistic methods. Author

N92-18579# Aerospatiale, Toulouse (France). FATIGUE TESTING AND TEAR DOWN OPERATIONS ON AIRBUS A320 FORWARD FUSELAGE

R. BOETSCH and J. Y. BEAUFILS In AGARD, Fatigue Management 6 p Dec. 1991

Copyright Avail: CASI HC A02/MF A03

The structural design substantiation of commercial transport aircraft is provided by full static and fatigue analyses supported by testing of complete primary structures. The fatigue and damage tolerance testing on full scale specimen representative of production aircraft and the teardown inspections performed at the end of the test permit the collection of a lot of data. Main objectives of fatigue tests are to identify weak points in primary structure and to quickly define corrective actions on in-service and production aircraft, and to check the efficiency of the inspection methods, to justify allowable damage and typical repairs of structural repair manuals, to study the propagation of artificial damages which are introduced during the test. The aim of teardown inspections is to verify and validate the inspection methods applied during the test on assembled structure and in addition to find hidden cracks with special nondestructive test methods. Also, from fatigue tests, areas will be found where there is a risk of wide spread fatigue damage and the performance of damage tolerance assessment on the basis of realistic cracking scenarios. Author

N92-18580# Alenia, Torino (Italy). Gruppo Aerei Difesa.

PROPOSAL FOR THE NEW FATIGUE MANAGEMENT SYSTEM FOR THE AMX

P. AMABILE and T. GIACOBBE In AGARD, Fatigue Management 9 p Dec. 1991

Copyright Avail: CASI HC A02/MF A03

The structural monitoring systems produced for the Italian Air Force are briefly presented and discussed. From the previous experience, a new proposal for AMX aircraft monitoring arose and is shown. The proposed system is based mainly on in-flight monitoring of strain gage measurements with storage of some flight parameters for special investigations or simplified back-up analysis in case of failures of the main system. Elaboration methods to be used both on-board and on ground are described. Measurements on static and fatigue tests on ground were studied for a correct tuning of the system. Author

N92-18582# Aeritalia S.p.A., Naples (Italy). Viale dell'Aeronautica.

THE G-222 AIRCRAFT INDIVIDUAL TRACKING PROGRAMME

A. MINUTO (Aeritalia S.p.A., Naples (Italy).), A. APICELLA (Aeritalia S.p.A., Naples (Italy).), A. LANCIOTTI (Pisa Univ. (Italy).), and L. LAZZERI (Pisa Univ., Italy) In AGARD, Fatigue Management 7 p Dec. 1991

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The G-222 is a transport aircraft designed about 20 years ago; from the fatigue point of view, the design is of the conventional 'safe life' kind, verified by means of a full scale test. The aircraft was equipped with a counting accelerometer, whose recordings were used, together with the pilot compiled forms, for the evaluation of life consumption. In recent years, following the Damage Tolerance evaluation of the structure, a different approach has been developed for fatigue damage monitoring; the same input data are used for the prediction of crack growth. The main drawback of this approach is the lack of information about the sequence of load application, so that only non-interactive models can be properly used. For this reason, Aeritalia decided to improve the quality of in-flight recorded parameters, in order to get more data about the actual usage, while also taking the sequence of load application into account. The data acquisition approach is described and discussed. Author

N92-18583# National Aerospace Lab., Amsterdam (Netherlands).

LOAD MONITORING OF F-16 A/B AIRCRAFT OF THE RNLA F WITH A SMART ELECTRONIC DEVICE

D. J. SPIEKHOUT In AGARD, Fatigue Management 17 p Dec. 1991

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Since the introduction of the F-16 weapon system in the RNLA F, load monitoring has been carried out with a mechanical strain

recorder (MSR) in each aircraft and a flight loads recorder (FLR) in one sixth of the fleet. From 1990 on, these recorders have been replaced by instrumentation which is capable of recording peaks and troughs in the signal of a strain gage at the location of the MSR. This new instrumentation has been installed in three aircraft per squadron. The result is a calculated severity per mission type per squadron. By using the mission type mixture, the severity per base, squadron or tail number can be established. Inspection schemes, based on the recently developed fleet structural maintenance plan for the RNLAF, can be changed accordingly. Mission type and take off configuration for each flight is available from the debriefing form. Besides the single channel measurements, supporting measurements with more channels have been carried out. In this way, it was checked whether the load severity for the MSR location can be used for other structural locations. Author

N92-18584# Industrieranlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).

AIRCRAFT TRACKING FOR STRUCTURAL FATIGUE

R. NEUNABER /in AGARD, Fatigue Management 9 p Dec. 1991

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Aircraft tracking is carried out for flight safety reasons, but with an increasing tendency also for economic reasons. With the latter aspect the cost-to-performance ratio becomes more and more important. To take care of both, for the WS Tornado, the parametric data acquisition of the crash recorder was extended to a multi-level tracking concept composed of the sectors temporary aircraft tracking, selected aircraft tracking, and individual aircraft tracking. The key elements of flight monitoring are the flight recorders that are distributed throughout all squadrons on a statistically representative basis and that register operating data for Selected Aircraft Tracking. In the Temporary Aircraft Tracking sector, the recorder parameter set also contains strain gauges in the various fatigue critical areas. Cyclical reading of these strain gauges ensures that any faults are revealed in the parametric algorithms. Individual Aircraft Tracking is carried out on the basis of a reduced pilot parameter set. The data transfer from the aircraft to the evaluation center for this task was converted from manual registration to electronic data processing, increasing the data processing capacity and at the same time significantly improving data quality. Author

N92-18585# Dassault-Breguet Aviation, Saint Cloud (France). Structure Div.

AIRCRAFT TRACKING OPTIMIZATION OF PARAMETERS SELECTION

R. J. CAZES and P. DEFOSSE /in AGARD, Fatigue Management 12 p Dec. 1991

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Any appropriate structural maintenance plan, based on a Safe-Life or a Damage Tolerance concept, is in close relation with the accuracy of in-service loads identification. The development of multichannel devices with integrated capabilities for in-flight pre-processing allows one to get in-service data and flight results about any critical part of the equipped aircraft, but with sometimes such an amount of computations that the 'should-be simple' in flight processing has to be transferred toward a ground facility. In order to reduce the volume of data for calculations (and their cost of acquisition), we studied the relative influence of the various flight parameters considered during the static and fatigue design of an aircraft. The calculated stresses and loads were compared with their same counterparts measured in flight. Their effects on fatigue values were quantified. This study was performed for the MIRAGE 2000 aircraft tracking and in service loads identification. Author

N92-18586# Deutsche Airbus G.m.b.H., Bremen (Germany).

THE OPERATIONAL LOADS MONITORING SYSTEM, OLMS

V. LADDA and H.-J. MEYER /in AGARD, Fatigue Management 14 p Dec. 1991

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The preservation of the damage tolerance qualities ensures the safe lifelong operation of aircraft. For this purpose and the assessment of fatigue life consumption, different methods have been developed to monitor the service experiences. Nowadays mainly two kinds of monitoring systems which are different in philosophy exist: first, the parametric system which records and processes only aircraft mission parameters, and second, the direct load/and or stress measurement system using strain gauges. The main advantages and disadvantages of both systems are discussed. A third possibility is to monitor the service experiences of aircraft by combining the advantages of both systems: this leads to the idea of Operational Loads Monitoring System (OLMS). In this contribution the advanced operational loads monitoring system OLMS, for a transport aircraft, is presented. Detailed descriptions are given concerning philosophy and realization. OLMS represents the on-board equipment for the Airframe Condition Monitoring Procedure (ACMP) which takes care of damage tolerance qualities and which will increase the efficiency of structural inspections. The OLMS as presented in this contribution is adaptable to all transport and combat aircraft with electronic flight control systems (EFCS). The verification has been performed on the test aircraft by means of strain gauge measurements. Results of the OLMS-computer simulation program as well as results of the flight test verification are presented. Author

N92-18591# Ministry of Defence, London (England).

AIRCRAFT FATIGUE MANAGEMENT IN THE ROYAL AIR FORCE

M. E. J. RENDER (Ministry of Defence, London (England).) and J. E. STEVENS (Royal Air Force, Dereham, England) /in AGARD, Fatigue Management 14 p Dec. 1991

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An overview of how fatigue is managed for all of the Royal Air Force (RAF) Aircraft Fleets is presented. The main theme is the Tornado Aircraft since it represents the largest portion of the capital value of the RAF inventory. The RAF has three objectives for their aircraft structural integrity policy: to make aircraft operations as safe as is reasonably possible; to ensure that the aircraft are available to the front line; and to minimize the costs. Author

N92-18592# Bundesamt fuer Wehrtechnik und Beschaffung, Munich (Germany).

TORNADO STRUCTURAL FATIGUE LIFE ASSESSMENT OF THE GERMAN AIR FORCE

PAUL FRAAS (Bundesamt fuer Wehrtechnik und Beschaffung, Munich (Germany, F.R.)) and AMBROS GOELLNER (Industrieranlagen-Betriebsgesellschaft m.b.H., Ottobrunn, Germany, F.R.) /in AGARD, Fatigue Management 10 p Dec. 1991

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The structural development and the fatigue verification of the Tornado Program was completed. The majority of the aircraft were delivered to the German Air Force and some of them were in full operational use for a period of one decade. This is considered a suitable time to review the approach for ensuring the long-term structural airworthiness, from the users point of view. Author

N92-18593# Portuguese Air Force, Alfragide.

FATIGUE MANAGEMENT FOR THE A-7P

DANIEL SANTOS /in AGARD, Fatigue Management 19 p Dec. 1991

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One objective of an Aircraft Structural Integrity Program (ASIP) is to ensure that all primary structure is both durable and damage tolerant; that is, it is able to resist both cracking and failure due to cracking. The heart of any durability and damage tolerance assessment is crack growth predictions. This requires a crack growth program, accurate stress intensity and load interaction models, and reliable material properties. With these tools, both durability analysis and damage tolerance analysis can be performed. All potentially critical locations were assumed to exhibit slow crack growth. No fail-safe concepts were used, although many locations have alternate load paths that carry the limit load. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

N92-18776# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel. **MANOEUVRING AERODYNAMICS** Nov. 1991 287 p In ENGLISH and FRENCH Meeting held in Toulouse, France, 1-2 May 1991 (AGARD-CP-497; ISBN-92-835-0643-X; AD-A245302) Copyright Avail: CASI HC A13/MF A03

This volume contains the 17 papers presented at the Advisory Group for Aerospace Research & Development (AGARD) Fluid Dynamics Panel (FDP) Specialists' Meeting on Maneuvering Aerodynamics. In addition to these papers, the general discussion held at the end of the meeting and the Technical Evaluation Report are included. This FDP sponsored meeting and document reflect the growing interests in rapid, large-amplitude aircraft maneuvers at high angles of attack and highlights the importance of the unsteady separated, vortical and often nonlinear characteristics of the aerodynamic flows that exist under such conditions. Developments in pertinent experimental techniques, relevant aerodynamic data and their applications to flight behavior predictions, importance of time lags, methods for forebody vortex control, and flight tests of the X-31A aircraft are among the topics discussed.

N92-18779# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Deutsche Aerospace/Military Div. **X-31 ENHANCEMENT OF AERODYNAMICS FOR MANEUVERING BEYOND STALL** HANNES ROSS In AGARD, Manoeuvring Aerodynamics 12 p Nov. 1991 Copyright Avail: CASI HC A03/MF A03

Current fighter aircraft are generally limited to angles of attack (AOA) below their maximum lift capability. Pilot inputs and aircraft maneuvering usually become limited when approaching the stall limited. Primary reasons for this situation are the degrading aerodynamic lateral/directional characteristics and reduced control power in the high AOA regime, often resulting in uncontrolled maneuvers/departures/spins. For these reasons, some aircraft reduced roll control inputs as well as Aileron-/Rudder-Interconnect (ARI) Systems installed to avoid uncoordinated flight conditions at higher AOA. Others have limitations as to the number of consecutive rolls they are allowed to fly even in the conventional AOA. Others have limitations as to the number of consecutive rolls that are allowed to fly even in the conventional AOA regime to prevent uncontrollable pitch-up/Beta excursions due to inertia coupling and engine gyroscopic moments. In the last ten years, new efforts have started to improve control capability in this flight regime. F-14, F-15, and F-18 have demonstrated AOA excursions up to about 65 degrees and the Su-27 and MIG-29 have performed impressive pitch maneuvers even exceeding AOA's of 90 degrees. However, all of the above mentioned maneuvers are performed in the pitch plane with little or no capability left for roll control around the velocity vector. A number of experimental aircraft programs were initiated to explore the high AOA and the poststall regime to broaden the knowledge base. The flight test objectives range from basic understanding and investigation of aerodynamic flow phenomena (X-29, a/c no. 2 high AOA test vehicle, F-18 High AOA Research Vehicle (HARV)) to the incorporation of thrust vectoring capability (HARV) and finally to the demonstration of technical feasibility and tactical utility of high AOA maneuvering (X-31 A). Author

N92-18781# Alenia, Torino (Italy). **PREDICTION OF AERODYNAMIC PHENOMENA LIMITING AIRCRAFT MANOEUVRABILITY** A. FERRETTI, A. BARTOLI, and A. SALVATORE In AGARD, Manoeuvring Aerodynamics 10 p Nov. 1991 Copyright Avail: CASI HC A02/MF A03

The synthesis of recent experiences concerning the effects of shock induced separation on conventional airplanes flying at high subsonic speeds are presented. Efforts were concentrated in synthesizing a prediction criterion for detecting onset of the wing aerodynamic phenomena leading to buffet and mishandling of such airplanes. Comparison of mishandling and buffet onset envelopes

theoretically derived with those experimentally measured on an airplane is given evidencing the consistency of the methodology. For nonconventional, highly swept wings featuring leading edge vortical flow at high subsonic speed and moderate angle of attack, the analysis of wind tunnel results has allowed the definition of a prediction criterion for transition from attached to vortical flow. This change in the wing flow structure is responsible for remarkable nonlinearities in the aerodynamic coefficients of the aircraft and could limit maneuverability in certain areas of the flight envelope. Efforts in implementing these concepts in the aerodynamic design process of such wing planforms are stressed as well as the need for further studies concerning a deeper understanding of the fluid dynamic conditions ruling the vortex breakdown. Author

N92-18782# Aeronautica Macchi S.p.A., Varese (Italy). Aerodynamics Dept. **PARAMETRIC EFFECTS OF SOME AIRCRAFT COMPONENTS ON HIGH-ALPHA AERODYNAMIC CHARACTERISTICS** L. VISINTINI, R. PERTILE, and A. MENTASTI In AGARD, Manoeuvring Aerodynamics 11 p Nov. 1991 Copyright Avail: CASI HC A03/MF A03

A wind tunnel test activity was performed with the purpose of defining and understanding the high angle of attack aerodynamic characteristics of an advanced trainer aircraft configuration. The tests included static and rotary balance measurements in the full 0 to 90 degree angle of attack range. The presentation includes a discussion of effects of model breakdown and of forebody finess ratio and cross section. Examples are also given about special difficulties related to subscale high angle of attack wind tunnel testing. Author

N92-18786# Aeronautical Research Inst. of Sweden, Bromma. **WIND TUNNEL FORCE MEASUREMENTS AND VISUALIZATION ON A 60-DEG DELTA WING IN OSCILLATION, STEPWISE MOTION, AND GUSTS** PER-AKE TORLUND In AGARD, Manoeuvring Aerodynamics 13 p Nov. 1991 Copyright Avail: CASI HC A03/MF A03

A 60 deg delta wing has been tested in pitching motion in a low-speed wind tunnel. Harmonic oscillation tests with 4 and 8 deg amplitude at 0 to 35 deg angle of attack were carried out. The reduced frequency was between .003 and .195. Both dynamic aerodynamic derivatives and time histories of the normal force and pitching moment were recorded. The same model was also tested in a stepwise motion up to 90 deg angle of attack. The steps were positive and negative with 20 deg amplitude starting every 10 deg, also steps over the full 90 deg were made. The angle of attack rates were chosen to correspond to the oscillation tests, the maximum being 360 deg/s and the acceleration 13500 deg/s(exp 2). The tunnel speed was 57 m/s in most cases and the centerline chord was .5 m. The response to the step motion was compared to the response predicted from the results of the oscillation tests. Author

N92-18787# Institut de Mecanique des Fluides de Lille (France). **CHARACTERIZATION OF UNSTEADY AERODYNAMIC PHENOMENA AT HIGH ANGLES [CARACTERISATION DE PHENOMENES AERODYNAMIQUES INSTATIONNAIRES A GRANDE INCIDENCE]** O. RENIER In AGARD, Manoeuvring Aerodynamics 21 p Nov. 1991 In FRENCH; ENGLISH summary Copyright Avail: CASI HC A03/MF A03

Dynamic maneuvers of an aircraft at high angles of attack are known to be the origin of unsteady, large amplitude aerodynamic phenomena. These phenomena cannot be neglected if the control of aircraft attitudes and movements has to be optimized. Such unsteady effects can be characterized on specific wind tunnel test facilities. Already effects of large incidence and sideslip variations of various aircraft geometries have been measured on the IMFL rotary balance during oscillatory coning motions. They have been globally taken into account in mathematical models using transfer functions. An original test apparatus was set up in

the IMFL low speed wind tunnel. Various dynamic pitch and/or yaw motions can be carried out on an aircraft model: sinusoidal or constant angular rate motions or typical pointing maneuver attitude evolution. The large performance of this apparatus allows the characterization and analysis of small and large amplitude, high angles of attack aerodynamic phenomena. Those test facilities are described, their dynamic simulation potentialities illustrated by some results and modelization techniques used are presented.

Author

N92-18789# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

X-31: DISCUSSION OF STEADY STATE AND ROTARY DERIVATIVES

W. KRAUS *In* AGARD, Manoeuvring Aerodynamics 32 p Nov. 1991

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The X-31A high agility airplane was designed to operate with excellent aerodynamic qualities not only in the normal flight regime, but also at high angles of attack. The aircraft was designed to have natural aerodynamic stability about all three axis in the entire angle of attack range, except at small angle of attack, where the aircraft is unstable in pitch for performance reasons. In some critical regions in which the natural stability cannot be attained, the control power required to achieve stability is provided to the appropriate axis by artificial control, still leaving sufficient control power for maneuvers. In a basic wind tunnel development program, a configuration was tailored which fulfills most of the demanded requirements by aerodynamic means. Both the results and the method of obtaining these results is presented. Besides this static behavior, each aircraft has dynamic characteristics, which decide whether or not the aircraft will diverge. Additional wind tunnel tests was conducted in a spin tunnel to evaluate these characteristics. An analysis of the data is presented including steady state spin modes.

Author

N92-18790# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.

USE OF STEPWISE REGRESSION TECHNIQUES AND KINEMATIC COMPATIBILITY FOR THE ANALYSIS OF EAP FLIGHT DATA

A. R. PERKINS *In* AGARD, Manoeuvring Aerodynamics 12 p Nov. 1991

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An investigation is described into the capabilities and accuracy of an equation error method of aerodynamic parameter identification using stepwise regression techniques. The results of the method are presented for flight responses of the British Aerospace EAP aircraft which has multiple control surfaces and high levels of longitudinal instability together with significant nonlinearities in the aerodynamic data. The benefit of kinematic compatibility processing of the flight data is also presented. The EAP flight responses are analyzed up to an incidence of 30 deg using a technique for joining together several maneuvers to form larger data bases for analysis. The derivatives extracted by these techniques agree in general with the results of the wind tunnel measurements.

Author

N92-18794# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).

TRANSFORMATION OF FLIGHTMECHANICAL DESIGN REQUIREMENTS FOR MODERN FIGHTERS INTO AERODYNAMIC CHARACTERISTICS

PETER MANGOLD *In* AGARD, Manoeuvring Aerodynamics 15 p Nov. 1991

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Recent experience in the design of highly augmented modern fighter aircraft with basically unstable characteristics in pitch have shown that the early integration of flightmechanical requirements into the aerodynamic optimization process is mandatory. Maximum allowable instabilities and control power requirements will set remarkable constraints to the freedom of aerodynamic design and influence essential components of the aircraft. Because of the

complex aerodynamic effects at high angles of attack, it will be necessary to approach the 'basic configuration' by some optimization loops. During the whole process, specialists from flight mechanics, aerodynamics, and overall design departments have to form a close team in order to end up with an excellent, well balanced design. It was proven that a set of criteria which represents a platform of common discussion for the specialist groups 'aerodynamics', 'flight mechanics', and 'control law designers' within early phases of a new fighter project can be and must be established in order to avoid unexpected, time consuming and costly difficulties in later design phases.

Author

N92-19701 Cranfield Inst. of Tech., Bedford (England).

A STUDY OF THE AEROELASTIC BEHAVIOUR OF HELICOPTER ROTOR BLADES FEATURING SWEEPED TIPS
Ph.D. Thesis

R. H. MARKIEWICZ 1990 302 p

Avail: Univ. Microfilms Order No. BRDX93762

The design of a model helicopter rotor blade incorporating a swept tip is described. The swept tip is chosen to provide a coupling between the lift at the tip and the blade twist, thus achieving a variation of blade twist with azimuth and with forward speed. The design is the first step in an investigation of aeroelastic tailoring as a means of reducing helicopter vibration and increasing rotor performance. The first prototype blade encountered stability problems and further designs were evaluated using a new modes/stability computer program developed within RAE. Comparisons are made between the stresses measured on a second stable swept tip blade and a dynamically similar rectangular blade. The results show that a beneficial twisting of the swept tip blade is achieved which enhances rotor performance and reduces the flatwise bending and torsional moments. Comparisons are made between the experimental results and those predicted by the RAE/WHL for the flatwise moments, but a more representative model of the hub is needed to produce acceptable predictions of the torsional moments. The design of a further set of blades is discussed, the aim being to investigate the effects of introducing a strong coupling between the flap and torsion motions of the blade by sweeping back the shear center. An analysis of the results shows that there are large gains in blade stability with no severe adverse effects on blade loads. A theoretical investigation was undertaken to observe the effects of tip sweep on the performance of a full size rotor. The results show that aft tip sweep can reduce control loads and rotor power for a rotor with a cambered aerofoil section.

Dissert. Abstr.

N92-20795# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace Vehicle Design.

A FATIGUE ANALYSIS OF THE TF89 TACTICAL FIGHTER AIRCRAFT M.S. Thesis

D. C. ELLIS Sep. 1990 188 p

(ETN-92-90657) Copyright Avail: CASI HC A09/MF A02

The fatigue life of the TF89 tactical fighter aircraft is determined. Five representative mission profiles are evolved and proportioned to describe the life of the airplane. These form the basis of all subsequent calculations. Analysis of maneuver, gust and ground loads is undertaken to determine the normal and lateral load spectra that would be applied to the airplane during its service life. These spectra are used to perform S-N curve and fracture mechanics analyses of selected metal components to test them for compliance with the relevant defense standard.

ESA

N92-21951# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

AIRCRAFT SHIP OPERATIONS

Nov. 1991 340 p *In* ENGLISH and FRENCH Symposium held in Seville, Spain, 20-23 May 1991

(AGARD-CP-509; ISBN-92-835-0641-3; AD-A244869) Copyright Avail: CASI HC A15/MF A03

The Symposium considered problems of mutual interest connected with fixed and rotary wing aircraft operations from ships, and the application of new technology to enhance such operations.

The topics covered included the ship environment in terms of wind, temperature, precipitation, turbulence, and deck motion; guidance, controls, and displays, primarily in the approach and landing phase; flight test and simulation techniques; launch, recovery, and handling systems developments; operational/pilot views; and future developments.

N92-21964# Agusta Sistemi S.p.A., Varese (Italy). Flight Test Dept.

EH 101 SHIP INTERFACE TRIALS: FLIGHT TEST PROGRAMME AND PRELIMINARY RESULTS

R. LONGOBARDI, G. VISMARA, and B. PAGGI *In* AGARD, Aircraft Ship Operations 7 p Nov. 1991
Copyright Avail: CASI HC A02/MF A03

The development program of the EH 101 includes, for its naval variant, the investigation of the ship-helicopter interface characteristics to grant a preliminary release for helicopter operations on board Italian and British Navy units. The testing will be done according to the following scheme: (1) EH 101 handling qualities assessment while operating near a ship, during the final approach phase; (2) deck landings and take-offs for a preliminary identification of deck motion limits and wind envelope; (3) assessment of the deck landing technique with the use of landing aids; (4) assessment of the aircraft landing on the deck, rotors folding, refueling, armament loading, taxiing, tie downs, etc.; (5) assessment of helicopter operations in a heavy electromagnetic environment; and (6) assessment of the maintainability characteristics of the EH 101 in limited spaces (engine and gear boxes change). Additionally, the results of the preliminary sea trials carried out with the EH 101 prototypes will be presented. Author

N92-21966# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Rotary Wing Performance Section.

UNITED KINGDOM APPROACH TO DERIVING MILITARY SHIP HELICOPTER OPERATING LIMITS

B. A. FINLAY *In* AGARD, Aircraft Ship Operations 14 p Nov. 1991 Sponsored in part by Ministry of Defence
Copyright Avail: CASI HC A03/MF A03

In the United Kingdom the Aeroplane and Armament Experimental Establishment (A&AEE) is responsible for conducting trials to determine the limitations appropriate to military Ship Helicopter Operations. The philosophy behind these trials is presented. Additionally, the many considerations which play a part in successful trials are discussed. The tests which are carried out before trials at sea are described together with details of how trials are conducted with a helicopter and a ship to determine the widest possible operating envelopes. It is concluded that the methods used by the A&AEE establish envelopes for any particular combination of aircraft and ship that are both operationally valuable and safe. Author

N92-21970# Dassault-Breguet Aviation, Saint Cloud (France). Direction General Technique.

DYNAMIC PERFORMANCE OF AN AIRCRAFT ON ITS LANDING GEAR: TEST AND EVALUATION ON A DIHEDRAL [COMPOTEMENT DYNAMIQUE D'UN AVION SUR SES ATTERRISEURS: EXPERIMENTATION ET VALIDATION PAR FRANCHISSEMENT D'UN DIEDRE]

D. FLEYGNAC and E. BOURDAIS *In* AGARD, Aircraft Ship Operations 13 p Nov. 1991 *In* FRENCH
Copyright Avail: CASI HC A03/MF A03

The essential role of the dynamic performance of landing gear in this study of instances of contact with the ground and, more particularly, the analysis of catapulting marine aircraft has justified the desire to validate the models used in the design phase of existing aircraft. Described here is the preparation, installation, and use of a dihedral to launch a MIRAGE 2000. These trials permitted a detailed identification of the performance characteristics of landing gear in a particular dynamic phase that is fairly representative of the conditions encountered when catapulting, as well as the aerodynamic effectiveness of control surfaces with ground effect. Author

N92-21971# British Aerospace Public Ltd. Co., Lancashire (England). Advanced Studies Dept.

SOME IMPLICATIONS FOR ADVANCED STOVL OPERATION FROM INVINCIBLE CLASS SHIPS

K. AINSCOW and P. G. KNOTT *In* AGARD, Aircraft Ship Operations 10 p Nov. 1991
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Replacing the Sea Harrier with a high performance Advanced Short Takeoff and Vertical Landing (ASTOVL) design for use on Invincible class ships was studied. Four different ASTOVL propulsion concepts are discussed. The integration of these larger, heavier aircraft with the small ship carrying EH101 helicopters is discussed. It is shown that the constraints of the ship and the size and performance of the aircraft require some changes in operational procedures when compared with Sea Harrier practice. The higher takeoff thrust to weight ratio and more hostile exhaust plumes suggest the use of the aft deck for recovery, a shorter deck run with the sky ramp for launching, and a blast deflector between the two areas. A study of the deck environment generated by the ASTOVL aircraft indicates that a delicate balance among size, mass, performance and exhaust environment will need to be struck in future Sea Harrier replacement studies for small ship operation. Author

N92-21973# Stato Maggiore Marina, Rome (Italy).

LIMITATIONS ON HELICOPTER OPERATIONS IN THE AERONAVAL ENVIRONMENT [LIMITATIONS DES OPERATIONS DES HELICOPTERES DANS LE MILIEU AERONAVAL]

D. FALCINELLI *In* AGARD, Aircraft Ship Operations 6 p Nov. 1991 *In* FRENCH

Copyright Avail: CASI HC A02/MF A03

The particular problems faced by pilots during flight activities onboard military ships are discussed. Problems include limited space, motion of the flight deck, wind, and turbulence. Various situations were studied using helicopters, but the results can be generalized to other types of aircraft. Problems of approach and landing are of special interest. Limitations of the environment, systems that help flight operations, markings and visual cues, landing and relocation systems, and approach systems are briefly discussed. Author

N92-22000# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Munich (Germany). Materials and Structures Research Dept.

MATERIALS AND STRUCTURES RESEARCH DEPARTMENT: SCIENTIFIC REPORT (1990)

DOROTHEA KOCH-PETERS, ed. and MARIANNE SALEIN, ed. 1991 151 p *In* ENGLISH and GERMAN Original contains color illustrations
(ISSN 0174-3910)

(ETN-92-90727) Avail: CASI HC A08/MF A02

The research and development tasks are directed towards two basic requirements of aircraft construction, ultraweight structures and high efficiency propulsion systems, towards the main challenges of hypersonic and reentry flight, high temperatures and temperature gradients, and towards related problems of energy technology. The scope of the research department's work stretches from materials research to design, construction and processing methods, to structural-dynamic and aeroelastic performance, and to testing and qualification of aerospace devices, supplemented by investigations of innovative materials and substances to be produced under zero gravity conditions. In detail the following activities are being pursued: production technology and materials research on production of rapidly solidified metals, fiber-reinforced Al, Mg, and Ti alloys, monolithic and fiber-reinforced high performance ceramics, fiber-reinforced plastics, layers providing protection against heat and corrosion, monocrystalline materials; material and function-adapted design principles, methods of producing and shaping components, lay-up and adhesion methods for laminates, assembly procedures, powder metallurgy, hot isostatic pressing, reaction sintering, slip-casting, infiltration techniques, automated production processes; calculation and

investigation of the static, dynamic and aeroelastic performance of components and structures (rotor blades, airframe, spacecraft, buildings); the damage mechanics of fiber compounds, thermomechanics, hybrid constructions, modal coupling, and entire systems. ESA

N92-23227# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

INTEGRATED DESIGN ANALYSIS AND OPTIMISATION OF AIRCRAFT STRUCTURES

Feb. 1992 212 p The 72nd meeting was held in Bath, England, 29 Apr. - 3 May 1991 (AGARD-R-784; ISBN-92-835-0653-7; AD-A248257) Copyright Avail: CASI HC A10/MF A03

At its 72nd meeting, the Structures and Materials Panel held a workshop to address the role of integrated design analysis and optimization of aircraft structures in order to review and evaluate modern computer codes, and the methodologies for their use. The workshop provided a very useful forum for the exchange of information which is reflected in the papers presented in this report. Among the topics covered are: aerodynamics, aeroelasticity, active control, composite materials, multidisciplinary design and optimization, fin design and optimization, and sensitivity analysis.

N92-23232# Saab-Scania, Linköping (Sweden). Aircraft Div.

THE STRUCTURAL OPTIMIZATION SYSTEM OPTSYS: CURRENT STATUS AND APPLICATIONS

TORSTEN BRAMA In AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 9 p Feb. 1992 Copyright Avail: CASI HC A02/MF A03

OPTSYS is a modular structural optimization system with well-defined interfaces to finite element (FE) programs and codes for aeroelasticity. A mathematical programming approach is adopted where a sequence of convex approximations of the initial problem is solved, using the method of moving asymptotes (MMA). This approach makes it possible to take all design criteria into account simultaneously. Gradients are calculated semi-analytically. OPTSYS can treat design variables associated to the shape of the structure, the element cross section properties, or the material direction in the case of composite materials. Constraints can be defined on displacement, stress, eigenfrequency, local buckling, flutter, and aileron efficiency. Recent developments have concerned the constraints on dynamic response and acoustics. Other important gradients are: the integration of a preprocessor to define shape variables, the treatment of discrete variables, and the possibility to deal with substructured FE models. The current status of the system capabilities and methods will be discussed and illustrated with applications on aircraft and automotive structures. Author

N92-23233# British Aerospace Public Ltd. Co., Lancashire (England).

APPLICATION OF AN AUTOMATED MULTIDISCIPLINARY ANALYSIS AND OPTIMISATION SYSTEM TO THE DESIGN OF AIRCRAFT STRUCTURES

D. THOMPSON and J. C. AYRES In AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 61 p Feb. 1992 Copyright Avail: CASI HC A04/MF A03

Prior to the development of the ECLIPSE system, structural optimization was performed by a combination of software and manual methods. These methods proved their worth by the reduction in costs and improvements in quality resulting from their use. The program used for optimization of structures subject to stiffness criteria became the focus for development of the aeroelastic constraints. This was later extended to incorporate strength constraints, fabrication constraints, and was coupled directly to the NASTRAN analysis system. This process of development continued with the result of the present general resizing, optimization, and post-processing system. This paper describes the application of the system to the optimization of three structures: tail plane, fin/rudder, and foreplane. The emphasis is on the use of the system to optimize for a flutter speed constraint

in all three cases. However, in the case of the foreplane, the adaption of the system to include a detail stressing constraint is illustrated. A brief description of some of the developments proposed for the future is also given. Author

N92-23236# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Airplane Div.

FIRST APPROACH TO AN INTEGRATED FIN DESIGN

G. SCHNEIDER, J. KRAMMER, and H. R. E. M. HOERNLEIN In AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 10 p Feb. 1992 Copyright Avail: CASI HC A02/MF A03

The present paper is focused on findings and results of an integrated design optimization study for an aircraft fin. The basic flight mechanics design requirement for a vertical fin is to provide a specified control power inside the whole flight envelope with a minimum weight structure. A method of implicit function theorem has been applied on our MBB fin sample problem. The definition of state variables and independent variables will be discussed in detail. Three basic aerodynamic parameters have been chosen for the sensitivity analysis: taper ratio, aspect ratio, and surface area. This aerodynamic sensitivity analysis has been performed by the finite difference method. The necessary finite element models of the structure have been generated in the same way as the aerodynamic model for the finite difference method. The applied method based on implicit function theorem has proven its capability to provide a transparent method with clear defined discipline interfaces which are essential to monitor a complex system. Author

N92-23239# Dassault Espace, Saint-Cloud (France).

STRUCTURAL OPTIMIZATION OF AIRCRAFT PRACTICE AND TRENDS

C. CORNUAULT, C. PETIAU, B. COIFFIER, and A. PARET In AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 12 p Feb. 1992 Copyright Avail: CASI HC A03/MF A03

After a general presentation of the CATIA-ELFINI tool, developed by DASSAULT, where computer aided design (CAD), structural analysis, and optimization are fully embedded, we focus on a detailed description of the optimization algorithm. We show the special features of optimization with composite materials. We present: (1) the new organization of design resulting from use of optimization techniques; (2) the application of our optimization techniques on the case of the MBB fin; and (3) techniques neighboring optimization as model adjustment and computation with uncertain data. We conclude by presenting further developments. Author

N92-23950# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.

SPECIAL COURSE ON ENGINEERING METHODS IN AERODYNAMIC ANALYSIS AND DESIGN OF AIRCRAFT

Jan. 1992 248 p Special course held in Ankara, Turkey, 6-10 May 1991, in Rhode-Saint-Genese, Belgium, 13-17 May 1991, and in Madrid, Spain, 20-24 May 1991; sponsored in cooperation with the von Karman Inst. for Fluid Dynamics (AGARD-R-783; ISBN-92-835-0652-9; AD-A247719) Copyright Avail: CASI HC A11/MF A03

Lecture notes for the AGARD Fluid Dynamics Panel Special Course on 'Engineering Methods in Aerodynamic Analysis and Design of Aircraft' have been assembled in this report. Proven engineering methods used during conceptual and preliminary design and development of new aircraft concepts are presented. These methods focus on simple computational procedures for conceptual and preliminary design, low level analysis computer codes, and experimental techniques for aircraft performance predictions. The course was aimed at helping train young engineers to appreciate and work with simple engineering tools to enhance the art of cost effective preliminary design of new aircraft.

N92-23951# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

INTRODUCTION TO SPECIAL COURSE ON ENGINEERING METHODS IN AERODYNAMIC ANALYSIS AND DESIGN OF AIRCRAFT

P. W. SACHER *In* AGARD, Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft 10 p Jan. 1992

Copyright Avail: CASI HC A02/MF A03

There are three major statements that characterize the findings of this special course. First, engineering work in aeronautical analysis and design is traditionally performed both through experiments and through numerical analysis. Second, an interdisciplinary approach is mandatory in conceptual and preliminary design work because although experiments will not be replaced by computational fluid dynamics (CFD), CFD may complement experiments by allowing quicker and more reliable selection of promising configurations. Third, engineering methods are indispensable because: high level CFD analysis is excluded in preliminary design; experimental work may be unavailable for configuration conception; and empirical low level flow code analysis and extrapolation from previous experience is the only logical consequence. H.A.

N92-23952# Dassault Espace, Saint-Cloud (France). Departement d'Aerodynamique Theorique.

COMPUTATIONAL PROCEDURES FOR PRELIMINARY DESIGN

P. PERRIER *In* AGARD, Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft 10 p Jan. 1992

Copyright Avail: CASI HC A02/MF A03

Preliminary design of aircraft has evolved largely over the past ten years. The main origin of the evolution came from the rationalization and broadening of the preliminary emphasis on new project development. The project has to be evaluated more quickly and the capability of a project to meet its requirements must be satisfied. This paper deals specifically with low level computations for preliminary design, and covers such areas as: center of pressure evaluation; lift evaluation; drag evaluation; air-intake integration; afterbody integration; and interactions with non aerodynamic requirements. H.A.

N92-23954# Aircraft Research Association Ltd., Bedford (England).

SURVEY OF EXPERIMENTAL TECHNIQUES FOR PERFORMANCE PREDICTION

A. B. HAINES *In* AGARD, Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft 60 p Jan. 1992

Copyright Avail: CASI HC A04/MF A03

This paper reviews the present state of the art in experimental testing in large wind tunnels as a means of predicting aircraft performance. Desirable and attainable standards of accuracy are defined and the paper lists and discusses the factors that contribute to this accuracy. Topics covered include: balances and pressure scanners; quality of tunnel flow; correction of data for wall interference; extrapolation of scale model data to full scale aircraft Reynolds numbers; and propulsion interference effects. Author

N92-23955# National Aerospace Lab., Amsterdam (Netherlands).

PANEL METHODS FOR AERODYNAMIC ANALYSIS AND DESIGN

H. W. M. HOEIJMAKERS *In* AGARD, Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft 47 p Jan. 1992

Copyright Avail: CASI HC A03/MF A03

An overview is presented of several aspects of panel methods used in the aerodynamic analysis and design of aircraft or aircraft components. Panel methods can provide the flow about complex configurations and are routinely used in the analysis of the aerodynamics of realistic aircraft shapes. However, panel methods are based on a mathematical model in which much of the fluid physics is ignored. The report discusses the capabilities and limitations of panel methods, the basic concepts of the panel

method, choices that can be made in the basic implementation of the concepts, as well as possible types of boundary conditions that can be utilized to creatively model subsonic and supersonic flow. The discussion also includes aspects of the accuracy of the approximation, consistent formulations, aspects of low and high order panel methods, etc. Also discussed are the computational aspects of panel methods and possible extensions to nonlinear compressible flows, coupling with viscous flow methods, and applications to other flow problems. Author

N92-24009 ESDU International Ltd., London (England). NORMAL FORCE OF LOW ASPECT RATIO WING-BODY COMBINATIONS UP TO HIGH ANGLES OF ATTACK AT SUPersonic SPEEDS

Nov. 1991 15 p Supersedes ESDU-68022

(ISSN 0141-397X)

(ESDU-91042; ESDU-68022; ISBN-0-85679-804-5) Avail: ESDU

ESDU 91042 presents a method that applies to delta, cropped delta, or rectangular wings mounted on an axisymmetric body at mid-height. It applies to Mach numbers between 1.2 and 5 to configurations with thin, sharp-edged wings with aspect ratio between 0.2 and 4 at angles of attack up to 60 degrees. The method takes the isolated wing normal force (from ESDU 90013), factored to account for body interference on the wing and wing interferences on the body (using ESDU 91007) and to account for interference from the body vortices, and adds the body contribution (from ESDU 89014 or 90034). The vortex interference factor is provided graphically and depends on the point of separation of the vortices for which another graph provides data. The method applies for zero or near zero roll angle to both cruciform and monoplane wings. When predicted values were compared with experimental values extracted from the literature an accuracy of 10 percent was indicated. This is illustrated for results in the angles of attack range of 20 to 25 degrees, and the ranges of experimental parameters used are tabulated. A worked example illustrates the use of the method. ESDU

N92-24966# Technische Univ., Delft (Netherlands). TOWARDS GLARE: THE DEVELOPMENT OF A FATIGUE INSENSITIVE AND DAMAGE TOLERANT AIRCRAFT MATERIAL Ph.D. Thesis

GERARDUS HUBERTUS JO ROEBROEKS 1991 273 p

Sponsored by Akzo Zout Chemie

(ETN-92-91301) Avail: CASI HC A12/MF A03

The constant amplitude fatigue behavior of ARALL is investigated. The fatigue crack growth rates in ARALL 2 increase considerably when failure of the crack bridging fiber layers occurs. This fiber failure behavior was studied. The influences of fatigue loading conditions and specimen geometry, are shown. The fiber failure model was used to develop a material in which fiber failure does not occur. In this material (GLARE), high strength glass fibers are used instead of aramid fibers. The strength (both notched and unnotched specimen) of ARALL and a first version of GLARE are compared. A clear advantage of GLARE over ARALL is found. The composition of GLARE is optimized. ESA

N92-25591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Flugabteilung.

THE DLR TEST AIRCRAFT IN FZ-BS VFW614/ATTAS, DORNIER DO228-101, MBB BO 105-S-3 [DIE DLR-VERSUCHSLUFTFAHRZEUGE IM FZ-BS, -VFW 614/ATTAS, DORNIER DO 228-101, MBB BO105 S-3]

HANS-L. MEYER *In* its Flight Test of Avionic and Air-Traffic Control Systems p 9-34 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The different test aircraft used by DLR are described. The Dornier DO-228-101 is an all metal airplane with mid set wings and two turboprop engines. The fuselage has a rectangular cross section and is not pressurized. The reference flight trajectory can be very accurately measured with a view to the control of navigation and landing systems. The flying helicopter simulator BO-105 S-3

is highly maneuverable and contains controllable main and tail rotors. The flying simulator, ATTAS (Advanced Technologies Testing Aircraft Systems), was developed starting from a short range jet, the VFW 614, such that flight trajectories and maneuvers of other models can be tested and checked under flight conditions. ESA

N92-25594# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.
INTRODUCTION AND EXECUTION OF FLIGHT TESTS AT THE DLR [EINLEITUNG UND ABWICKLUNG VON FLUGVERSUCHEN IN DER DLR]

HELMUT BOTHE *In its* Flight Test of Avionic and Air-Traffic Control Systems p 57-70 Jul. 1991 In GERMAN
 Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The different test stands available for an efficient execution of flight tests are described. The onboard equipment comprises an airborne system for the reference flight path, avionics sensor systems, a data acquisition and transmission system, aeronautical radio systems, and an experimental cockpit. The ground equipment comprises a tracking radar, a laser radar, a kinothedolite system, a telemetry receiver system with online data processing, a gyroscope test system, the air traffic simulator ATMOS, a ground test vehicle, and a high frequency radiation system. ESA

N92-25596# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.
TESTING OF AN EXPERIMENTAL FMS [ERPROBUNG EINES EXPERIMENTELLEN FMS]

VOLKMAR ADAM *In its* Flight Test of Avionic and Air-Traffic Control Systems p 85-104 Jul. 1991 In GERMAN
 Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The development of an Experimental Flight Management System (EFMS) and the validation and testing of the EFMS functions in a given test environment are discussed. The present air traffic control problems can only be solved by an integrated Air Traffic Management (ATM) system. Therefore, new FMS functions must be developed and their efficiency demonstrated in a simulated scenario of the future situation. The EFMS presently being developed in the framework of the program PHARE (Program for Harmonized ATM Research in Eurocontrol) is flexible and easy to adapt to experimental requirements. The testing procedure of the EFMS in flight and in connection with air traffic simulation is outlined. ESA

N92-26944# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abt. Aerodynamik und Flugmechanik.
SEPARATION OF EXTERNAL STORES: COMPARISON OF RESULTS

H. AFFOLTER 12 Feb. 1991 53 p In GERMAN; ENGLISH summary
 (F+W-TF-2058; ETN-92-90820) Avail: CASI HC A04/MF A01

Different methods allowing prediction of the separation behavior of external stores from an aircraft are presented. The separation of two different external fuel tanks from a Mirage 3 aircraft is shown, and the results of the different methods are compared. The separation behavior predicted by wind tunnel tests and computer calculations is confirmed with good accuracy in flight tests. ESA

N92-27870# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON FLYING QUALITIES

HAROLD ANDREWS (Aviation Systems and Research, Arlington, VA.) Apr. 1992 22 p
 (AGARD-AR-311; ISBN-92-835-0665-0) Copyright Avail: CASI HC A03/MF A01

The validity of constraining the responses of today's control dominant aircraft to conform to the classic flying qualities criteria derived from stability dominant aircraft experience has been an issue for many years. The introduction of full time visual scene enhancement with sensor fusion, and computer generated/interpreted night scenes, and the use of integrated flight and propulsion control schemes and direct force controllers have expanded flight envelopes, reduced drag, increased maneuverability, provided the framework for practical gust alleviation and active flutter suppression, and provided flexibility for fault-tolerant, damage-adaptive flight controls. However, the updating of flying qualities criteria has in general not kept pace with these technological changes. The Flight Mechanics Panel of AGARD therefore decided to organize a Symposium to review flying qualities issues today, and to report progress towards their resolution. The topic areas included: Flying Qualities Experiences on Contemporary Aircraft; Application of Flying Qualities Specifications; Flying Qualities Research and Flying Qualities at High Incidence. This Technical Evaluation Report evaluates the presentations and discussions in each session, draws relevant conclusions and makes recommendations for future activities in this area. The papers presented at this Symposium are published as AGARD Conference Proceedings 508. Author

N92-28468# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

AIRCRAFT SHIP OPERATIONS [LE COUPLE AERONEF-NAVIRE DANS LES OPERATIONS]

J. G. HOEG (Naval Air Test Center, Patuxent River, MD.) Apr. 1992 13 p Presented at the Flight Mechanics Panel Symposium, Seville, Spain, 20-23 May 1991
 (AGARD-AR-312; ISBN-92-835-0668-5; AD-A253805) Copyright Avail: CASI HC A03/MF A01

Worldwide interest in the use of shipborne aircraft as a major weapons system is very broad. Many NATO countries operate fixed wing aircraft from ships. Additionally, the use of ships as helicopter platforms is extensive in the NATO community and brings another important dimension to the aircraft/ship interface issue. Thus, it seemed that both fixed and rotary wing aviation deserved equal billing in the Aircraft/Ship Interface Symposium which is the subject of this Technical Evaluation Report. The Symposium contained twenty-five presentations grouped under the following topics: Keynote Addresses; Ship Environment; Guidance, Controls, and Displays; Flight Test and Simulation Techniques; Launch, Recovery, and Handling Systems Development; and Operational Views and Future Developments. Author

N92-28469# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

INTEGRATED DESIGN ANALYSIS AND OPTIMISATION OF AIRCRAFT STRUCTURES [L'ANALYSE INTEGRALE DE LA CONCEPTION ET L'OPTIMISATION DES STRUCTURES DES AERONEFS]

May 1992 88 p Lectures held in Pasadena, CA, 8-9 Jun. 1992, in Lisbon, Portugal, 22-23 Jun. 1992, and in London, England, 25-26 Jun. 1992

(AGARD-LS-186; ISBN-92-835-0675-8; AD-A255373) Copyright Avail: CASI HC A05/MF A01

There is a lack of precise information on the effectiveness of specific methods in generating optimum designs for realistic aircraft structures. In this situation it is difficult for designers to make decisions on which systems to employ for a given design problem and which developments to pursue. Thus, it is necessary for designers to be aware of the relative merits of the different methods currently used for the design optimization of advanced aircraft. This lecture series covers the methods available for the computer based design analysis and design optimization of aircraft structures. The lecture series deals with the principles and practices adopted to integrate the various factors which are considered in the design of advanced aircraft. These factors include: structural shape,

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

aerodynamics, active control technology, and aircraft performance.

N92-28470# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace Science.

FUNDAMENTALS OF STRUCTURAL OPTIMISATION

A. J. MORRIS *In* AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 13 p May 1992
Copyright Avail: CASI HC A03/MF A01

Structural optimization is concerned with the computerized automatic design of structures which are optimum with respect to some major design parameter. In the aircraft industry this parameter has usually been structural weight, though cost, performance, or other factors are now being considered. The general problem which is characterized here remains unchanged so that the basic nature of the optimization problem is the same for all applications. Also the structural optimization problem is always characterized by the finite element method (FEM). The use and application of these methods to computer aided design (CAD) requires some understanding of the underlying mathematical principles. It is shown that this process of developing solution methods use the optimization criteria as the basis for creating the up-date formulae which are the solution algorithm drivers. H.A.

N92-28471# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

PRACTICAL ARCHITECTURE OF DESIGN OPTIMISATION SOFTWARE FOR AIRCRAFT STRUCTURES TAKING THE MBB-LAGRANGE CODE AS AN EXAMPLE

J. KRAMMER *In* AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 16 p May 1992
Copyright Avail: CASI HC A03/MF A01

The structural optimisation system MBB-Lagrange allows the optimization of homogeneous isotropic, orthotropic or anisotropic structures as well as fiber reinforced materials. With the simultaneous consideration of different requirements in the design of aircraft structures it is possible to reduce the number of iteration steps between design, analysis and manufacturing. Based on finite element methods for structures and panel methods for aerodynamics, the analysis with sensitivity includes modules for static, buckling, dynamic, static aeroelastic and flutter calculations. The optimization algorithms consists of mathematical programming methods and an optimization and analysis/sensitivity is the optimization model which leads to a very modular architecture. Typical application examples show the power and generality of the approach. Author

N92-28472# Dassault (E. M.) Co., Saint Cloud (France).

STRUCTURAL OPTIMIZATION OF AIRCRAFT

C. CORNUAULT and C. PETIAU *In* AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 17 p May 1992
Copyright Avail: CASI HC A03/MF A01

A general survey of Dassault experience and knowledge on Aircraft Design with Optimization Methods is depicted. This survey results from compiling the developments and the results already worked out and already presented in several papers. Part 1 gives a detailed description of the methodology. The special features of optimization with composite materials are shown. The organization of design resulting from use of optimization techniques is described and techniques neighboring optimization as model adjustment are reviewed, as well as further developments. Part 2 illustrates this methodology by an actual case study of an aircraft design by Dassault-Aviation with relevant examples of structural and aeroelastic optimization on carbon structures of a wing and a fin. Author

N92-28474# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

MATHEMATICAL OPTIMIZATION: A POWERFUL TOOL FOR AIRCRAFT DESIGN

OTTO SENSBURG *In* AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 19 p May 1992
Copyright Avail: CASI HC A03/MF A01

Formal mathematical optimization methods have been developed during the past 10 to 15 years for the structural design of aircraft. Together with reliable analysis programs like finite element methods they provide powerful tools for the structural design. They are efficient in at least two ways: (1) producing designs that meet all specified requirements at minimum weight in one step; and (2) relieving the engineer from a time consuming search for modifications that give better results, they allow more creative design modifications. MBB has developed a powerful optimization code called MBB-Lagrange which uses mathematical programming and gradients to fulfill different constraints simultaneously. Some examples depicting the successful application of the MBB-LAGRANGE code are presented. Also results of other optimization codes are shown. The paper closes with an outlook on how the optimization problem could be enlarged to include the shape and size of airplanes. Author

N92-28531# Royal Aerospace Establishment, Bedford (England). FMS Div.

VALIDATION OF SIMULATION SYSTEMS FOR AIRCRAFT ACCEPTANCE TESTING

A. A. WOODFIELD *In* AGARD, Piloted Simulation Effectiveness 4 p Feb. 1992
Copyright Avail: CASI HC A01/MF A03

There is currently a limited role for simulation in flight clearance of sub-systems in civil aircraft. However, the extensive use of simulation for manned space vehicle clearance shows the potential for simulation to join other rigs in flight clearance. There is a serious risk that simulation could prove inadequate if there is no systematic validation program. Simulation is a complex integration of models of vehicles and the environment, physical sensation devices and the pilot. Any of these can be modified to compensate for inadequacies in parts of the simulation. This can be acceptable for training simulators but is not acceptable for clearance activities because the influence of such modifications cannot be predicted in situations that are not going to be tested in flight. These issues are discussed. Author

N92-28634# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

IMPROVEMENT OF SEPARATIONS OF PRACTICE BOMBS FROM A MULTIPLE BOMB ADAPTER

K. R. RIJZEBOL 31 Aug. 1990 32 p Presented at the 8th Aircraft/Stores Compatibility Symposium, Fort Walton Beach, FL, 23-28 Oct. 1990 Submitted for publication Sponsored by Royal Netherlands Air Force
(NLR-TP-90307-U; ETN-92-91447) Avail: CASI HC A03/MF A01

In the search for a small and easy to handle practice bomb rack, the Multiple Practice Bomb Adapter (MPBA) to be used for training on the F-16 was investigated. An initial exploratory flight test program with this tandem two place MPBA did not show adverse characteristics. In a subsequent delivery flight test program, film recordings revealed bomb to pylon or bomb to adapter contact of both the Mk-106 and BDU-33D/B practice bombs. Flight tests with a rack with a heavily modified aerodynamically shape showed still unacceptable separation behavior. Additional mechanical modifications, consisting of spring type 'tail up restrictors', were applied. These modified bomb racks produced satisfactory separation characteristics for the BDU-33D/B practice bomb throughout the required release envelope. The Mk-106 produced considerable deflection of the tail up restrictors. A more rigid design of the tail up restrictor was then constructed for the original MPBA and was flight tested. The test results showed that the tail up restrictors do prevent collisions of bomb tails with the MPBA, the parent pylon, or the aircraft. The practice bombs separate positively and clear from the aircraft. ESA

N92-28649# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

THE USE OF LOAD ENHANCEMENT FACTORS IN THE CERTIFICATION OF COMPOSITE AIRCRAFT STRUCTURES

J. LAMERIS 22 Feb. 1990 60 p

(Contract OV/RLD-987)

(NLR-TP-90068-U; ETN-92-91432) Avail: CASI HC A04/MF A01

In the full scale durability and damage tolerance tests of composite aircraft structures, the U.S. and European certification requirements demand among other things that the number of cycles applied are statistically significant and that the influence of the environment has been taken into account. Several certification methods which take into account the requirement of having sufficient statistically reliable data are described. A review of the way in which these requirements are interpreted and applied in four composite aircraft certification programs in particular with regard to the application of so called enhancement factors is given. ESA

N92-28651# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

MODIFICATIONS AND RESULTS OF FLIGHT TESTS OF A PRACTICE BOMB ADAPTER

K. R. RIJZEBOL 30 Mar. 1990 11 p Sponsored by Royal Netherlands Air Force
(NLR-TP-90108-U; ETN-92-91434) Avail: CASI HC A03/MF A01

The Royal Netherlands Airforce was searching for a small light and easy to handle practical bomb rack. Initial exploratory delivery flight tests with the tandem two place Multiple Practice Bomb Adapter (MPBA), carried at the outboard wing pylons of the F-16 aircraft, did not show adverse characteristics. A report on comparable flight tests with the A-7 Corsair was also positive. In a delivery flight test program to collect scoring data, high speed 16 mm movie recordings revealed bomb to pylon or bomb to adapter contact of both Mk-106 (at moderate airspeed) and BDU-33D/B (at higher speed) within the required release envelope. Subsequently, the aerodynamic shape of the practice adapter was modified. The internal, mechanical properties and the rack of aircraft interface remained unchanged. Flight tests with the modified rack showed still unacceptable separation behavior. After providing spring type 'tail up restrictors' to the original and to the aerodynamically modified bomb rack, satisfactory separation characteristics were demonstrated by the BDU-33D/B practice bomb throughout the required release envelope. A more rigid construction of the tail-up restrictor will probably produce satisfactory separation characteristics of the Mk-106 practice bomb as well. A comparison of the bomb adapter before and after modification and the results of the flight test programs are presented. ESA

N92-28687# National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Div.

LAH-MAIN ROTOR MODEL TEST AT THE DNW

J. W. G. VANNUNEN (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.)), C. HERMANS (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.)), and H.-J. LANGER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) 10 Aug. 1990 14 p Presented at the 16th European Rotorcraft Forum, Glasgow, Scotland, 18-21 Sep. 1990 Previously announced in IAA as A92-35771

(NLR-TP-90305-U; ETN-92-91446) Avail: CASI HC A03/MF A01

In the context of a feasibility and cost definition study for the A129 LAH, a wind tunnel experiment was executed in the wind tunnel on a dynamically and Mach scaled mode of the main rotor. The tests aimed at getting more reliable answers to the question of which of the proposed rotor configurations would fulfil the stringent flight performance requirements of the new helicopter best. The rotor diameter amounted to 3.5 m. Four different rotor configurations were examined, the variations being either in the blade tip shape or in the twist distribution along the span of the blade. The dynamic characteristics of the various blade configurations were found to agree reasonably well. An exception in this respect should only be made for those blade configurations that have swept back tips. These specific blades exhibit definitely lower torsional frequencies than comparable blades with straight tips. The rotor torque measured on the model rotor correlates well up to 130 kts with the torque as determined during flight

tests. Comparing the different rotor configurations considered during the present test, the high twist blade set is found to produce the highest vibration levels at the higher advance ratios. ESA

N92-29616# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

RESULTS OF A FLIGHT SIMULATOR EXPERIMENT TO ESTABLISH HANDLING QUALITY GUIDELINES FOR THE DESIGN OF FUTURE TRANSPORT AIRCRAFT

J. A. J. VANENGELLEN 8 Jul. 1988 18 p Presented at the AIAA Flight Mechanics Conference, Minneapolis, MN, 15-17 Aug. 1988

(NLR-MP-88044-U; GARTEUR-TP-051; ETN-92-91514) Avail: CASI HC A03/MF A01

An experiment on a flight simulator is presented. The main results are discussed and compared with the contemporary handling qualities criteria used to design the flight control system. The experiment was defined and executed in moving base flight simulator. Emphasis of this experiment was put on longitudinal handling qualities. Test pilots evaluated 2 primary and 2 backup systems during a 3 day period in 2 levels of environment disturbances. Fully electrical fly by wire flight control systems stabilize the aircraft and enable the pilot to directly control a predetermined flight parameter. The necessary control surface deflection is determined by an onboard computer. For such advanced aircraft it is imperative to investigate whether existing handling qualities criteria can still be used for the design of primary and backup system, and particularly, whether guidelines are required to cover the change introduced when a failure occurs and the flight control system reverts to a backup system with different characteristics. ESA

N92-29650# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Aircraft Div.

CONCURRENT ENGINEERING IN DESIGN OF AIRCRAFT STRUCTURES

J. KRAMMER, O. SENSBURG, J. VILSMEIER, and G. BERCHTOLD 27 Sep. 1991 36 p Presented at the 73rd AGARD Structures and Materials Panel Meeting, San Diego, CA, 7-11 Oct. 1991

(MBB-FE-2-S-PUB-472; ETN-92-91500) Copyright Avail: CASI HC A03/MF A01

The concurrent engineering idea in design of aircraft structures is explained and its meaning is depicted by showing several examples from the design and manufacturing process for new airplanes. Time and cost savings can be achieved if the concurrent engineering philosophies are also applied very early to cover reliability and supportability aspects. ESA

N92-30424# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Aircraft Div.

MULTIDISCIPLINARY OPTIMIZATION OF FIBER COMPOSITE AIRCRAFT STRUCTURES

H. A. ESCHENAUER (Siegen Univ., Germany, F.R.), G. SCHUHMACHER (Siegen Univ., Germany, F.R.), and W. HARTZHEIM 12 Dec. 1991 15 p Presented at the NATO/DFG Advanced Study Institute on Optimization of Large Structural Systems, Berchtesgaden, Fed. Republic of Germany, 23 Sep. - 4 Oct. 1991

(MBB/FW321/S/PUB/476; ETN-92-91902) Copyright Avail: CASI HC A03/MF A01

The application of a method of structural optimization to find optimal layouts of fiber composite structures in aircraft construction is addressed. The goal of the optimization process is to minimize the structural weight and, simultaneously, to fulfill multidisciplinary constraints concerning failure criteria, stability requirements, dynamic responses, aeroelastic efficiencies and flutter speeds. Considering these requirements, the optimal values for the layer thickness and the fiber orientations of composite structures must be determined. This problem can efficiently be solved by structural optimization methods. The model formulation in structural optimization is described in general as well as the special optimization model and the structural and sensitivity analysis for

fiber composite structures. An application example demonstrated the performance of the whole procedure. This example shows that the structural optimization method is very useful to increase the efficiency of the design process as well as the quality and performance of aircraft structures. ESA

N92-31515# Cranfield Inst. of Tech., Bedford (England). College of Aeronautics.

ASTOVL COMBAT AIRCRAFT DESIGN SYNTHESIS AND OPTIMIZATION

N. KEHAYAS Jan. 1992 279 p Sponsored by RAE (CRANFIELD-AERO-9201; ISBN-1-871564-360; ETN-92-91728) Avail: CASI HC A13/MF A03

The development of a baseline configuration for an Advanced Short Take Off and Vertical Landing (ASTOVL) combat aircraft is presented. The design synthesis and coding of these baseline configuration (code VERTI), the interfacing of the design synthesis code VERTI with the optimizer code RQPMIN, and the optimization of the baseline configuration, are presented. ESA

N92-33750# Rolls-Royce Ltd., Derby (England).

THE ROLLS-ROYCE TRENT

GILES HARVEY 1 May 1991 15 p Presented at the Royal Aeronautical Society, Hong Kong, China, May 1991 (PNR-90875; ETN-92-92185) Copyright Avail: CASI HC A03/MF A01

The design philosophy of the wide bodied Trent aircraft is discussed and principal design features are described. The Trent is a derivative of the RB211 family. The consistent design approach through three generations is outlined. The unique wide-chord fan blade manufacturing sequence, involving superplastic forming and diffusion bonding, is described. A computer model of the engine structure of the Trent 800, and performance retention features, are shown. Structural analysis and design, including finite element analysis, is described. ESA

N92-70575 National Aerospace Lab., Amsterdam (Netherlands). **DEFINITION OF P.S.D.-DESIGN LOADS FOR NONLINEAR AIRCRAFT**

R. NOBACK 17 Jan. 1989 65 p (Contract OV/RLD-837/940) (PB92-138619; NLR-TP-89016-U) Avail: CASI HC A04/MF A01

The Power Spectral Density (PSD) method is used to define design loads due to atmospheric turbulence. The design loads are calculated using linear transfer functions. These methods can not be used if the equations describing the behavior of the aircraft are nonlinear. One method to define design loads for a nonlinear aircraft is by means of computer simulation. The definition for the design loads as used in the PSD method are inadequate in this case. The necessary changes in the definitions of the design loads for a Design Envelope Analysis and a Mission Analysis are examined. In the DEA, the probability that the load exceeds the design load is used as a criterion. The proposed definitions are based on the use of a representative value of the standard deviation of the input and on the use of an approximation of the integrand representing the contribution of the input level to the probability of exceedance or the number of level crossings. The correlation between loads is also discussed. Author

N92-70591 National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN THE NETHERLANDS DURING THE PERIOD MARCH 1987 - MARCH 1989

J. B. DEJONGE Mar. 1989 24 p Presented at the 21st ICAF Conference, Jerusalem, Israel, 19-20 Jun. 1989 (PB92-138650; NLR-TP-89115-U) Avail: CASI HC A03/MF A01

A brief review is given of work performed in the Netherlands in the field of aeronautical fatigue. Where possible, applicable references are presented. Author

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A92-13699

TOMORROW'S COCKPIT DISPLAYS

A. C. B. SINGER and I. W. MCCLELLAND (Royal Aerospace Establishment, Bedford, England) Aerospace (UK) (ISSN 0305-0831), vol. 18, Nov. 1991, p. 12-14. Copyright

Research being done to develop the cockpit displays of tomorrow is discussed. The elements of advanced displays are described, and emphasis is given to 4D descent profiles and clearances. C.D.

A92-16148

CONCEPT FOR FUTURE COCKPITS [CONCEPT DE COCKPITS FUTURS]

JEAN-NOEL PERBET, JEAN-JACQUES FAVOT, and BRUNO BARBIER (Sextant Avionique, Saint-Medard-en-Jalles, France) L'Onde Electrique (ISSN 0030-2430), vol. 71, Nov.-Dec. 1991, p. 57-60. In French. refs Copyright

It is noted that future display devices will use multimedia systems allowing a multimode dialogue between man and the system. The concept of a large interactive display as applied to future cockpits is described. Attention is given to experiments on man-machine interaction and preliminary results of multimode dialogue. Experimental results indicate that an analysis of man-system interactions is necessary in order to create an optimal interface of multimode dialogue. L.M.

A92-18937

INFRA-RED OFFERS NEW LANDING AID COMPETITION

BILL SWEETMAN Interavia Aerospace Review (ISSN 0020-6512), vol. 46, Dec. 1991, p. 62-66. Copyright

An overview is presented of the development of civil enhanced visual systems (EVS), a forward looking FLIR/HUD combination that could be certificated for airliners within two years. EVS has evolved from FAA/USAF work in synthetic visual systems, the aim of which is to demonstrate redundant, all-weather landing guidance utilizing FLIR and millimeter-wave radar. One advantage of EVS over autoland is that it is an intuitive landing aid that makes all approaches visual, thus extending the pilot's performance rather than placing the pilot in the role of a monitor. R.E.P.

A92-22000

HIGH COSTS FORCE AVIONICS LINKS

BARRY MILLER Interavia Aerospace Review (ISSN 0020-6512), vol. 47, Jan. 1992, p. 45-53. Copyright

This review shows that the high costs required to perfect commercial flight decks are shaping alliances and risk-sharing ventures of avionics manufacturers. Some examples cited include the development of MD-12 FBW controls (Honeywell/GE), flight deck needs of new and retrofit aircraft (Collins/Smiths), and avionics suite for IL-96M (Collins/Ilyushin). Attention is given to some of the new avionic suites under development including electronic flight instrument systems, laser inertial reference, centralized fault display systems, fiber optic data bus, and a fault-tolerant air data inertial reference system. R.E.P.

A92-24918

A NEW THERMOMETRIC INSTRUMENT FOR AIRBORNE MEASUREMENTS IN CLOUDS

KRZYSZTOF E. HAMAN (Warsaw, University, Poland) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 9, Feb. 1992, p. 86-90. Research supported by Polish Academy

of Sciences. refs
Copyright

A new instrument for measuring the temperature of air in clouds from an aircraft is described. The instrument uses a very fine thermometric sensor located behind a thin rod that protects the sensor from direct contact with cloud droplets. Because the airflow is less disturbed than in more massive protective housings, the accuracy and speed of the sensor are relatively less affected than in other types of airborne contact thermometers. Details of the construction of a prototype unit and results of preliminary flight and wind tunnel tests are given. Author

A92-32080
USE OF RELATIVE HUMIDITY SENSORS FOR PLANES MEASUREMENT

G. ABADIE, G. COCHER, and C. BERNE (Etablissement d'Etudes et de Recherches Meteorologiques, Magny-les-Hameaux, France)
IN: Symposium on Meteorological Observations and Instrumentations, 7th, New Orleans, LA, Jan. 14-18, 1991, Preprints. Boston, MA, American Meteorological Society, 1991, p. 247-249. Copyright

The use of hygrometric measurement to determine the speed of French aircraft is described. The devices are summarized and sample hygrometric calculations and sounding results are briefly presented. C.D.

A92-35256
MEASUREMENTS OF OCEAN WAVE SPECTRA WITH THE RESSAC AIRBORNE RADAR

DANIELE HAUSER, GERARD CAUDAL (Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Issy-les-Moulineaux, France), and GERT-JAN RIJCKENBERG (Landbouwniversiteit, Wageningen, Netherlands) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 2021-2024. Research supported by ESA and CNES. refs
Copyright

The French radar system RESSAC, used from aircraft platforms for measuring directional spectra of ocean waves, is presented. The instrument is a C-band FM/CW radar, with antennas looking at near-nadir (7-21 deg) and scanning over 360 deg in azimuth. The procedure consists in relating the change in backscattering cross-section to the slope of long ocean waves. Using a Gaussian approximation for the slope probability density function, it is possible to estimate the sea surface slope variance, which in turn is used to determine the tilt modulation transfer function, without the need of any external wind measurement. Spectra obtained from RESSAC are presented and compared to other datasets (nondirectional frequency spectra from buoy measurements, directional spectra from a ship radar). The consistency is satisfactory, and the estimates of sea surface slope variance inferred from RESSAC are consistent with the wind observations. I.E.

A92-35742
INNOVATION IN THE LASER WARNING SENSOR FIELD

F. LIBERATI (Agusta S.p.A., Rome, Italy) and A. BIANCHI (Agusta S.p.A., Tradate, Italy) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 6 p.

The widespread use of such laser sources as those of range-finders, missile guiding target designators, and lidars, in prospective battlefield scenarios has prompted intensive development of laser warning sensors for helicopters and other aircraft. Attention is presently given to a novel laser detection system employing an arrangement of optical fibers. Design tradeoffs between beam-direction indicator accuracy and the amount of onboard hardware and software required are noted. O.C.

A92-35763
TEST ENGINEERING LANGUAGE FOR AVIONIC SYSTEMS
M. MAININI and G. P. MARIANI (Agusta S.p.A., Tradate, Italy)

European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 9 p.

The paper describes a test engineering language (called Test Engineering Language for Avionic Systems, TELAS) developed for testing complex avionic systems, which was employed during the development and testing of the EH 101 and A 129 integrated avionic systems. The TELAS architecture is based on a data base that contains all the parameters definitions and their initialization values related to Mil 155 bus station, Arinc 429 bus station, and aircraft sensor emulators, which characterize all the information that the unit under test exchanges with emulated aircraft equipment/sensors. The paper presents the structure, the formal syntax, and examples of TELAS language, as well as the specific environment where TELAS is used for both the host computer and the hardware architecture of the rig. I.S.

A92-35765
TRANSMISSION VIBRATION MONITORING - A SINGLE BOARD COMPUTER ARCHITECTURE

GABRIO MAGNI and FRANCO STRAZZULLO (Agusta S.p.A., Tradate, Italy) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 10 p.

The paper describes the architecture of a digital signal processor module capable of performing the acquisition and conversion of vibration signals coming from EH 101 helicopter transmission and of checking and processing the incoming data for obtaining shaft 'signature' parameters. Attention is also given to the requirements of transmission vibration monitoring and the methods used, the system implementation, the module performance and interfaces, and the software structure. This computer architecture has powerful capabilities in terms of processing and modularity and offers hardware reconfigurability provisions making it possible to modify the architectural structure to accept other helicopter functions. I.S.

A92-35941
THE SAS FLIGHT ANALYSIS AND AIRCRAFT MONITORING SYSTEM

MADS H. BRANDT (Scandinavian Airlines System, Copenhagen, Denmark) IN: Society of Flight Test Engineers, Annual Symposium, 21st, Garden Grove, CA, Aug. 6-10, 1990, Proceedings. Lancaster, CA, Society of Flight Test Engineers, 1990, p. 3.7-1 to 3.7-8. Copyright

A flight-analysis and monitoring system is described in terms of experimental aims, flight-monitoring principles, and the format of the PC-based system. The SAS New Flight Analysis and Monitoring System includes 7 modules for operational supervision and 8 modules for technical supervision including a daily exceedance analysis, periodic trend analysis, and aircraft/cockpit animation. The EDP environment is a local-area network with automatic processing, and special analyses can be requested for all plot/list parameter profiles. The data from flight operational monitoring is routinely analyzed for operational routine events and operational exceedance events. The operational exceedance events are classified according to severity and type, and the data can be requested in tabular or animated displays. The automatic PC-based system is of value for the flight analysis of a range of aircraft to determine the operational states. C.C.S.

A92-39963
ELS FOR THE A340

FRANCOIS GOUDENOVE (Aerospatiale, Paris, France) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 7 p.
(SAE PAPER 912111) Copyright

The Electronic Library System is a general designation for ground and airborne systems in charge of providing Aircraft operators with the information they need. For A330/A340 aircraft, the airborne system is LRU based and the flexibility required by Airlines is provided through a modular configuration. The Airborne Electronic Library System Man-Machine interface is designed to be consistent with the general cockpit design. In particular, the

flight crew display devices are integrated within the sliding tables in front of each pilot station. Author

A92-46243

FIBRE OPTIC ROTARY POSITION SENSORS FOR VEHICLE AND PROPULSION CONTROLS

PETER T. GARDINER (Smiths Industries Aerospace & Defence Systems, Ltd., London, England) IN: Integrated optics and optoelectronics II; Proceedings of the Meeting, San Jose, CA, Sept. 17-19, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 200-210.

Copyright

The requirements for displacement sensing and the way in which fiber-optic sensing technology can be harnessed to meet these requirements are examined. A particular design technique, a WDM digital encoding structure, is reviewed. A schematic of a typical aircraft control system is shown which illustrates where displacement sensors are needed, both for pilot input and for positional feedback in actuators. Parameters include: point measurement, high precision (0.1 resolution, ± 0.5 percent accuracy), absolute measurement (no recalibration after power down, compact rugged package, and interchangeability). The device can provide an unambiguous absolute reading of physical parameters, immune to source fluctuations and varying losses in the system. C.A.B.

A92-46247

THE USE OF OPTICAL SENSORS AND SIGNAL PROCESSING GAS TURBINE ENGINES

IAN DAVINSON (Rolls-Royce, PLC, Derby, England) IN: Integrated optics and optoelectronics II; Proceedings of the Meeting, San Jose, CA, Sept. 17-19, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 251-265. refs

The paper describes the application of optical measurement techniques to aircraft engine testing, including measurement profiles for turbine blade tip clearance, compressor blade vibration, fan blade profile, turbine blade temperature, and flow diagnostics. The signal and data processing associated with these techniques is emphasized and the prospects for further extending the use of optical methods on ground test and flight engines is discussed. The possibility of applying optical processing techniques is also addressed, with emphasis on high-temperature pressure sensors, efficiency measurements in multistage compressors, improved shaft timing probes, control sensors, and optical signal processing. C.A.B.

A92-46449

THROUGH THE LOOKING GLASS

HARRY HOPKINS Flight International (ISSN 0015-3710), vol. 141, no. 4321, June 3, 1992, p. 27-30.

Copyright

A review is presented of the development that has evolved in electronic flight instrument systems since the first civil color system saw commercial service a decade ago. Attention is given to the development of an electronic library system to integrate various data from navigation agencies, manufacturers and operators. R.E.P.

A92-48477

AN INTEGRATED NAVIGATION SYSTEM MANAGER USING FEDERATED KALMAN FILTERING

S. A. BROATCH and A. J. HENLEY (GEC Avionics, Ltd., Guidance Systems Div., Rochester, England) IN: NAECON 91; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 422-426. Research supported by Ministry of Defence Procurement Executive. refs

Copyright

A federated Kalman filter architecture has been developed in which the Kalman filter processing is distributed among the navigation sensors to be integrated. Each navigation sensor with

its Kalman filter can, in conjunction with the reference INS (Inertial Navigation System), be considered as a subsystem which functions as an independent manager. A central data fusion function is used to integrate the information from these navigators. Such a federated architecture can offer a number of advantages over one with a single central Kalman filter. These advantages include improved failure detection and correction, improved redundancy management, and lower costs for system integration. GEC Avionics has developed a system for the integration of INS with GPS (Global Positioning System) and TRN (Terrain Referenced Navigation), together with other navigation aids. Results are presented to demonstrate the performance and the benefits of using a federated approach. I.E.

A92-54324

SOME IMPORTANT FACTORS IN TURBULENCE IN FLIGHT MEASUREMENT

QING CHEN (Braunschweig, Technische Universitaet, Germany) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 206-213. refs

Copyright

A systematic analysis of each part of a data acquisition system and of each sensor that is involved in the measurement of air data and inertial data is presented. Because a data consistency check can handle the linear items fairly well, such as bias and scaling factor in the error model, the emphasis is on the time delay effect caused not only by the sensors and the data acquisition system but also by some other special factors. Based on these results a method is developed to correct the measured air data that are the combination of gust and inertial components with the relative time shift between them. The final influence of the time delay on the system identification is demonstrated by flight test data in a research aircraft. Some suggestions are given to improve turbulence measurement in flight. I.E.

A92-56291

INTEGRATED HELMET SYSTEM TESTING FOR A NIGHTFLYING HELICOPTER

H.-D. V. BOEHM and H. SCHREYER (MBB GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 16 p. refs

Two integrated helmet systems (IHSs) with a helmet-mounted sight (HMS) were tested in the laboratory and in helicopter flight trials. In the IHS, two image intensifier tubes and two cathode ray tubes are used with an optical system including combiners to present a binocular image. Additional symbology can be superimposed on the image. The HMS can steer a sensor platform with a thermal camera or an air-to-air missile system. The importance of flight testing for a full evaluation of the IHS for day and night flight capability is emphasized. V.L.

A92-56292

TEST AND INTEGRATION CONCEPT FOR COMPLEX HELICOPTER AVIONIC SYSTEMS

HORST GOELZENLEUCHTER and LOTHAR DIETL (MBB GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 6 p.

Experiences with integration rigs and test systems used on complex helicopter avionic systems are described. Advantages of the concept in use at the Messerschmitt-Boelkow-Blohm GmbH Helicopter Division are discussed, and general requirements for test systems for related applications (e.g., integration of civil helicopters, etc.) are outlined. The test means for the TIGER basic avionic system offer the required flexibility for the integration of the various national versions of this helicopter at the same test rig. The use of an off-the-shelf test system avoids any development risks of a 'self-made' solution. C.A.B.

N92-12532#

British Aerospace Public Ltd. Co., Preston (England).

DEVELOPMENT OF TACTICAL DECISION AIDS

W. G. SEMPLE *In* AGARD, Machine Intelligence for Aerospace Electronic Systems 6 p Sep. 1991
Copyright Avail: CASI HC A02/MF A03

British Aerospace is pursuing a program of research and development of computer aids (mission management aids) to assist the pilot in the management of combat missions. In addition to algorithms, many aids will have to exploit new concepts from software engineering to artificial intelligence. We have these new tools by which we expect that we can meet the new requirements. However, many of the conventional solutions are new to our experience, at least within the stringent requirements of real-time airborne computing, and many of the new tools are only partly developed or partly understood. This is especially true for some tactical MMAs. Author

N92-12536# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

EXPERT SYSTEM FOR THE TORNADO GROUND-BASED CHECK-OUT SYSTEM

J. FEY, J. MARANGOS, M. MERX, and W. MANSEL *In* AGARD, Machine Intelligence for Aerospace Electronic Systems 5 p Sep. 1991

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A technology demonstrator, supporting the TORNADO check-out system for aircraft was developed and tested. The expert system, called TORRES (TORNADO Radar Readiness Expert System), supports debriefing staff with various levels of experience. The scope of the error detection encompasses the TORNADO Terrain Following and Ground Mapping Radar system down to the module level. The main task of TORRES is the identification and isolation of errors that occurred during the previous flight. The expert system is also able to exclude errors that were generated by other systems capable of changing the state of the radar system and isolate the cause. Other influences, like EMC, exceeding avionic systems acceleration limits, and weather effects are taken under consideration and reported. If an error run is left without an associated case, special test runs are suggested. An explanation facility generates detailed debriefing reports. Author

N92-14046# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.

THE CONFLICTING FORCES DRIVING FUTURE AVIONICS ACQUISITION

Sep. 1991 207 p *In* ENGLISH and FRENCH Lecture series held in Kettering, MD, 16-17 Oct. 1991, in London, England, 4-5 Nov. 1991, and in Madrid, Spain, 7-8 Nov. 1991
(AGARD-LS-176; ISBN-92-835-0636-7; AD-A244244) Copyright Avail: CASI HC A10/MF A03

There is a growing need to develop flexible/robust avionics to meet ever changing mission needs of the operational forces. Such needs may conflict with other required characteristics such as standardization, increased reliability, durability, and integrity. Weapon system costs and associated avionics costs continue to increase while military budgets continue to shrink due to the changing world conditions. Thus, it is even more important to intelligently resolve these often conflicting forces driving development efforts. These evolving trends, conflicts, and challenges are examined with a view to enhancing dialogue, understanding, and improved planning.

N92-14050# Ministry of Defence, Paris (France). Integration Div.

AVIONICS STANDARDIZATION IN EUROPE

L. GUIBERT *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition 15 p Sep. 1991
Copyright Avail: CASI HC A03/MF A03

Avionics standardization in Europe has relied upon common standards, such as Stanags. That approach is not rigid enough to ensure real interoperability, as will be demonstrated with the Link 16 example. It is foreseen that one of the major challenges for future avionics standardization will be the modularity. For some reasons, there must be international commonality in order to obtain minimization of costs. One important issue is the applicability of

modular avionics on board European aircraft. This has been studied in France with relation to the Rafale. The results of that study will be discussed in some details. Another issue is the standardization of Instruction Set Architectures (ISA) in the field of data processing. That concept helps to solve some problems, such as software interchangeability and reconfigurability, but it also has drawbacks. A solution to the problem which does not imply common ISAs is predicted in France: the software bus. That concept, related to the Real Time Ada Extension program is proposed. It is clearly understood in Europe that modular avionics will gain maximum advantage if its F31 specifications are common to the different nations and services within NATO. This enforces the need for cooperation at both governmental and industrial levels. Europe has launched two multinational programs in order to define and validate a common avionics architecture for application in the next century: the ASAAC and the EUCLID CEPA 4. The scope and content of the first phase of these programs will be described. Author

N92-14051# Thomson-CSF, Malakoff (France). Radar and Counter-Measures Div.

MIXED APPROACH TOWARDS MODULAR AVIONICS CONFLICTING REQUIREMENTS

J. P. LACROIX *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition 10 p Sep. 1991

Copyright Avail: CASI HC A02/MF A03

New development efforts like PAVE-PILLAR and PAVE-PACE in the US, EUCLID CEPA 4 in Europe, aim at architecture selection or standards recommendations in order to satisfy at least three requirement domains: LCC (life cycle cost) requirements; performance requirements, and availability requirements. A tool is described (graphic capture and simulation) which aims to bring some methodological help for designing modular integrated avionics systems, by allowing a more accurate analysis of their dynamical behavior. The refinement of the system modelization is tightly dependent on the performance of the simulation package. Author

N92-14052# Ministry of Defence, London (England).

AVIONICS SOFTWARE EVOLUTION

JOHN A. TURTON *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition 17 p Sep. 1991

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The critical software related aspects are reviewed, where thorough planning and implementation of philosophies and principles are needed, in order to be able to develop software based avionic systems to meet target timescales and budgets. Some of the critical software technologies are identified that will facilitate this process, both today and in the near future. The implications are described for software resulting from the currently emerging modular avionic architectures. A central theme is that the system and software generation process should be placed on as formal a theoretical basis as possible. This is in order to be able to deal effectively with the complexity of the software based avionic systems that are just around the corner. Author

N92-14054# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Systems Engineering Branch.

AVIONICS SYSTEMS DEVELOPMENT: TECHNOLOGICAL TRENDS, CONFLICTS, AND COST ISSUES IN A CHANGING EUROPEAN ENVIRONMENT

HELMUT RAPP *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition 15 p Sep. 1991

Copyright Avail: CASI HC A03/MF A03

Presented here is an overview of German research and development projects generally known as modular avionics and their relationship to international initiatives. Growing system software complexity as well as rising software problems and cost have forced software development into rigid development methods and high order languages, and towards increasing standardization. Focussed upon are equipment standards that allow technology growth, maximize competition, and promote reusability of designs,

and the avionics system software evolution and the experiences gained in the German TORNADO and F-4F upgrade programs.

Author

N92-14057# Westinghouse Electric Corp., Baltimore, MD. Digital Systems Dept.

IMPLICATIONS OF INTEROPERABILITY AND STANDARDIZATION FOR THE INDUSTRIAL BASE

JOHN C. STUELPNAGEL *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition 6 p Sep. 1991

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A persistent problem for North Atlantic Treaty Organization (NATO) forces has been the difficulty of standardization and interoperability, due to conflicting political, economic, national, and industrial pressures. One approach to better accomplish standardization objectives has been the establishment of co-development programs, such as the Very High Speed Integrated Circuit (VHSIC) Avionics Modular Processor Program, in which the French and United States Governments have initiated the development of interoperable digital processing modules. However, conflicts in timing between development efforts and schedules for production and deployment of aircraft platforms has resulted in limited use of such modules in major aircraft programs. Several models for NATO standardization organizations are discussed which could address this problem and achieve significantly higher levels of interoperability in operational NATO equipment. Author

N92-25592# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

THE BASIC MEASURING TECHNICAL EQUIPMENT OF THE DLR TEST AIRCRAFT [DIE MESSTECHNISCHE GRUNDAUSRUESTUNG DER DLR-VERSUCHSFLUGZEUGE]

HELMUT BOTHE *In its* Flight Test of Avionic and Air-Traffic Control Systems p 35-48 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The measuring equipment systems of the ATTAS (Advanced Technologies Testing Aircraft Systems) and the DO 228 are described. The main aim of the basic equipment is to determine the necessary parameters, and to filter, prepare, adapt, and process the signals, via a comprehensive sensor system. The basic equipment of the ATTAS and the DO 228 is largely compatible, but the ATTAS equipment is substantially more extensive, while the Dornier equipment is more mobile and can be installed in other aircraft without much effort. An integrated pulse code modulation (PCM) system digitizes the analog sensor signals and provides a sequential PCM data flow. The PCM data can be transmitted to ground station. ESA

N92-25603# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.

ARRANGEMENTS AND METHODS FOR THE SURVEY OF AIRCRAFT RADIO COMPONENTS AND SYSTEMS [EINRICHTUNGEN UND METHODEN ZUR VERMESSUNG VON FLUGFUNKKOMponentEN UND -SYSTEMEM]

JUERGEN TETZLAFF *In its* Flight Test of Avionic and Air-Traffic Control Systems p 247-259 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

A flight survey system for the inflight measurement of RF components and systems (antenna radiation patterns, radar reflection characteristics) was developed. The modular measuring systems are automated to reduce the time and cost requirements. After an online data evaluation, the measurements provide the quantity to be analyzed as a function of an angle (aspect angle) which is correlated to the aircraft coordinate system. The measuring equipment is calibrated before the flight. ESA

N92-28376# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.

APPLICATIONS OF ASICs TO AVIONICS

Feb. 1992 49 p

(AGARD-AG-329; ISBN-92-835-0657-X) Copyright Avail: CASI HC A03/MF A01

An overview of how Application Specific Integrated Circuits (ASICs) can be a key factor in avionics systems is presented. The technical capabilities and possibilities of ASICs in avionics applications are discussed along with the essential characteristics and various types of ASICs that are available. The computer aided design (CAD) tools necessary for the rapid development of ASICs are discussed. Two specific examples of applications are cited: (1) the imbedded computers necessary for airborne radar digital signal processing; and (2) the ASIC role in image processing for aircraft cockpits.

N92-28379# Micro Circuit Engineering Ltd., Tewkesbury (England).

APPLICATIONS OF SILICON HYBRID MULTI-CHIP MODULES TO AVIONICS

E. S. ECCLES *In* AGARD, Applications of ASICs to Avionics 14 p Feb. 1992

Copyright Avail: CASI HC A03/MF A01

Silicon-based multi-chip modules (MCMs) are an inevitable byproduct of reduced feature size and higher speed integrated circuit (IC) devices. Early versions are available and are being exploited in military and high performance commercial applications. Their use will proliferate rapidly over the next four years and is likely to extend the use of monolithic ICs into performance areas which were previously inaccessible. Author

N92-28654# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

POTENTIAL APPLICATIONS OF LASER DOPPLER ANEMOMETRY FOR IN-FLIGHT MEASUREMENTS

H. W. JENTINK 9 May 1990 32 p

(NLR-TP-90163-U; ETN-92-91437) Avail: CASI HC A03/MF A01

The application of laser anemometry for flight testing and other aircraft related measurements is addressed. The laser anemometry technique and previous work in this field are reviewed and applications are described. A comparison of possibilities of laser anemometry with conventional techniques shows some unique advantages of laser anemometry. ESA

N92-29870# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. Flaechenflugzeuge.

SENSOR FAULT DETECTION ON BOARD AN AIRCRAFT WITH OBSERVER AND POLYNOMIAL CLASSIFIER Ph.D. Thesis - Technische Univ. [SENSORFEHLERERKENNUNG IN FLUGZEUGEN MIT BEOBACHTER UND POLYNOMKLASSIFIKATOR]

JOERG J. BUCHHOLZ Aug. 1991 65 p *In* GEORGIAN (ISSN 0939-2963)

(DLR-FB-91-34; ETN-92-91390) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

A sensor fault detection method for the airspeed vector of an aircraft is described. A nonlinear estimator uses a mathematical aircraft motion model and a few measured signals to generate an estimate of the airspeed vector to be monitored. This reference signal and the measurement signal are fed into a learning pattern recognition algorithm, which determined the state of the sensor from the differences between the two signals. In a practical realization, the classifier is parallelized, implemented on a transputer network, and verified using flight test data. ESA

N92-32437# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.

INTEGRATED TARGET ACQUISITION AND FIRE CONTROL SYSTEMS [SYSTEMES INTEGRES D'ACQUISITION D'OBJECTIFS ET DE CONDUITE DE TIR]

Feb. 1992 109 p *In* ENGLISH and FRENCH Symposium held in Ottawa, Canada, 7-10 Oct. 1991 Original contains color illustrations

(AGARD-CP-500; ISBN-92-835-0658-8) Copyright Avail: CASI HC A06/MF A02; 1 functional color page

The characterization of targets is of primary interest because it is needed for establishing the tactical situation, optimizing target acquisition, and optimizing armaments utilization. Due to the necessity of obtaining information on threats which have low signatures and are equipped with counter-measure systems, the operational specification of airborne systems have come to rely on the technologies providing multispectral analysis of targets. Specific topics discussed include aircraft fire control, air to air missiles, air to ground missiles, aerial warfare, multispectral detectors, integrated systems architectures and algorithms, and data fusion.

N92-32447# Zeiss (Carl), Oberkochen (Germany).

AIRBORNE EXPERIMENTAL FLIR PROGRAM

KLAUS F. BOECKING *In* AGARD, Integrated Target Acquisition and Fire Control Systems 12 p Feb. 1992

Copyright Avail: CASI HC A03/MF A02; 1 functional color page

The German Air Force has decided to build a forward looking infrared (FLIR) system in order to derive and to consolidate the different technical requirements for their different technical tasks. This FLIR design was designed and built on the basis of available and proven technologies. The equipment is pod-mounted in order to avoid modification of existing Tornado aircraft. Two different modes of operation are comprised in one hardware. These are the navigation mode, used as a pilot aid for flying at night and in adverse weather, and the fire control mode, used for passive targeting and navigation-update. The mechanical and optical designs are presented as well as the electronics architecture. The performance of the sensor system is described. Author

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

A92-15625

NUMERICAL SIMULATION OF UNSTEADY VISCOUS COMPRESSIBLE FLOWS APPLIED TO BLADE FLUTTER ANALYSIS

L. D. G. SIDEN (Volvo Flygmotor, AB, Trollhattan, Sweden) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 11 p. Research supported by Volvo Flygmotor, AB. refs (ASME PAPER 91-GT-203)

A numerical method for simulating quasi-three-dimensional unsteady viscous compressible flow is developed and applied to blade flutter analysis. The Reynolds-averaged Navier-Stokes equations are solved in a time accurate manner on a continuously deforming computational mesh. Turbulence is accounted for by the inclusion of a two-layer algebraic turbulence model. This method is compared with measurements and a full velocity potential solver for two different subsonic compressor cascades and a range of flow conditions. Both methods are found to predict unsteady attached flows reasonably well. However, the Navier-Stokes solver picks up the pressure fluctuations associated with the unsteady leading edge separation bubble. These types of fluctuations have large amplitudes and tend to dominate the cascade's aerodynamic damping behavior. Author

A92-15636

THE DESIGN AND TESTING OF A RADIAL FLOW TURBINE FOR AERODYNAMIC RESEARCH

I. HUNTSMAN, H. P. HODSON (Cambridge, University, England), and S. H. HILL (Rolls-Royce, PLC, Leavesden, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition,

36th, Orlando, FL, June 3-6, 1991. 7 p. Research supported by Rolls-Royce, PLC and Rolls-Royce Business Ventures, Ltd. refs (ASME PAPER 91-GT-220)

This paper describes the design of a high-speed radial inflow turbine for use as part of a gas-generator, and the design of a large-scale (1.2 m tip dia.) low-speed model of the high-speed turbine. Streamline curvature throughflow, two-dimensional blade-to-blade and fully three-dimensional inviscid and viscous calculation methods have been used extensively in the analysis of the designs. The use of appropriate scaling parameters and their impact on turbine performance is discussed. A simple model shows, for example, how to model the blade lean in the inducer which serves to balance the effect of meridional curvature at inlet to the rotor and can be used to unload the rotor tip. A brief description of the low-speed experimental facility is followed by a presentation and discussion of experimental results. These include surface flow visualization patterns on both the rotor and stator blades and blade row exit traverses. Author

A92-15720

THE SELECTIVE BLEED VARIABLE CYCLE ENGINE

MARCO A. R. DO NASCIMENTO and PERICLES PILIDIS (Cranfield Institute of Technology, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 7 p. refs (ASME PAPER 91-GT-388)

A new concept in aircraft propulsion is described in this paper. A variable cycle jet engine is being investigated for a supersonic STOVL aircraft. The engine is the selective bleed turbofan, a two shaft three compressor engine. At low flight speeds this engine operates as a medium bypass turbofan, and for the supersonic cruise condition it operates as a low bypass ratio turbofan in the dry mode. In this paper, the performance of the engine and some of the components is analyzed. Off-design engine performance characteristics are explained, compressor running lines are shown, and variable geometry requirements are described. The performance analysis shows that fuel savings are significant, thus reducing aircraft take-off weight. The major advantage of this engine is that all the components are employed all the time, for all operating modes, thus incurring low weight penalties. Author

A92-16666

THE APPLICATION OF HIGH PRESSURE EJECTORS TO REACTION CONTROL SYSTEMS

P. MILLER and M. W. R. SEEL (Bath, University, England) Aeronautical Journal (ISSN 0001-9240), vol. 95, Nov. 1991, p. 297-312. Research supported by SERC and British Aerospace, PLC. refs Copyright

A numerical analysis is conducted to ascertain the parameters which are critical to the achievement of high performance in thrust-augmenting ejectors for high-pressure reaction-control systems typical of VTOL aircraft. A novel method for the improvement of mixing in confined ejector flows is investigated experimentally for both sonic and supersonic primary flows. Performance is found to be sensitive to mixing efficiency in terms of the mixing duct exit flow's uniformity and primary nozzle losses. Attention is given to the difference in performance between underexpanded nozzles fitted with castellations and those leaving plain nozzles. O.C.

A92-17203

ISOTHERMAL MODELING OF GAS TURBINE COMBUSTORS - COMPUTATIONAL STUDY

P. KOUTMOS and J. J. MCGUIRK (Imperial College of Science, Technology, and Medicine, London, England) Journal of Propulsion and Power (ISSN 0748-4658), vol. 7, Nov.-Dec. 1991, p. 1064-1071. Research supported by Ministry of Defence of England. refs Copyright

Computations have been conducted for the swirl-driven recirculation flow of a swirl-stabilized tuboannular gas turbine combustor under isothermal conditions. The combustor geometry

07 AIRCRAFT PROPULSION AND POWER

is split into two zones; the flow in the exit nozzle is computed on the basis of a general method for complex geometries. Numerical model performance is assessed in view of LDA measurements of the velocity and turbulence fields. Discrepancies between predictions and measurements are noted to increase in the dilution region, and the predicted levels of turbulence energy are too low in regions of high anisotropy. Global aspects of isothermal flows were found to be representable with acceptable accuracy for preliminary-design purposes. O.C.

A92-17827#

ENGINE-AIRFRAME INTEGRATION FOR AEROSPACE PLANES - LESSONS FROM STS 2000 AND STAR-H STUDIES
ISABELLE DUBOIS, CLOTHILE PAURON (Hyperspace, Suresnes, France), ALAIN DUFOUR (Aerospatiale, Les Mureaux, France), MICHEL RIGAULT (Dassault Aviation, Saint-Cloud, France), and DOMINIQUE SCHERRER (ONERA, Chatillon, France) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 11 p. refs
(AIAA PAPER 91-5039) Copyright

A review of studies on French hypersonic launch vehicles and combined engines is presented, focusing on propulsion and its integration. It is shown that the best propulsion systems for vehicles utilizing airbreathing engines up to Mach 6 are the turbo expander for the TSTO concept STAR-H and the turborocket ramjet for the SSTO concept SST-2000. Both of these engines have the advantage of good specific impulse and weight compatible with the specifications. R.E.P.

A92-22137#

THE POSITION OF THE UNSTEADY FLOW COMPUTATION IN THE COMPRESSOR AND TURBINE DESIGN AND ANALYSIS PROCESS

GEORGES KARADIMAS (SNECMA, Moissy-Cramayel, France) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 11 p. refs
(AIAA PAPER 92-0015) Copyright

An evaluation is made of the development status and consequentiality of unsteady flow-simulating CFD techniques applicable in advanced gas turbine compressor and turbine stage design. The maximization of aircraft gas turbine thrust/weight performance and reliability while minimizing acquisition and maintenance costs fundamentally depends on the ability to anticipate the effects of unsteady aeromechanical phenomena. Attention is given to blade flutter and forced vibration, stator/rotor interactions, flow instabilities and distortions, and the evolution of CFD techniques to date. O.C.

A92-26376

CARS TEMPERATURE MEASUREMENTS AND VALIDATION OF A COMPUTING CODE ON A GAS-TURBINE COMBUSTOR [MESURES DE TEMPERATURE PAR DRASC ET VALIDATION D'UN CODE DE CALCUL SUR FOYER DE TURBOREACTEUR]
P. MAGRE, G. COLLIN (ONERA, Chatillon, France), D. ANSART, C. BAUDOUIN, and Y. BOUCHIE (SNECMA, Centre d'Essais de Villaroche, Moissy-Cramayel, France) (European Propulsion Forum 91, Paris, France, Nov. 13-15, 1991) ONERA, TP no. 1991-224, 1991, 15 p. In French. Research supported by EURAM. refs
(ONERA, TP NO. 1991-224)

The paper describes tests carried out within the framework of the European Low Emission Combustor Technology project, whose aim was to evaluate the potential of future combustor technologies for the reduction of pollution levels. First, ONERA applied CARS to obtain temperature profiles in the interiors and outlets of representative gas-turbine combustors. SNECMA then compared the results obtained with those obtained from classical test techniques for the qualification of combustor outlet conditions. In addition, measurements performed in the chamber interiors were used to validate the SNECMA computing code (3D, finite volumes, the SIMPLE algorithm) which guides the development of combustor chambers. L.M.

A92-29973

THE EFFECT OF AIR-COMPRESSOR ADJUSTMENT BY MEANS OF AIR-BLEED ON THE RESERVE OF ITS STABLE OPERATION [WPLYW REGULACJI SPRZARKI UPUSTEM POWIETRZA NA ZAPAS STATECZNEJ PRACY]

MAREK ORKISZ (Wyzsza Oficerska Szkola Lotnicza, Deblin, Poland) Rozprawy Inzynierskie (ISSN 0035-9408), vol. 38, no. 3-4, 1990, p. 397-404. In Polish. refs
Copyright

An analysis of the effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation is presented. The influence of the amount of bled air on the line position of the joint operation of a turbine and compressor in steady-state conditions is evaluated. P.D.

A92-31683#

FRENCH RESEARCH AND TECHNOLOGY PROGRAM ON ADVANCED HYPERSONIC PROPULSION

BRUNO DEBOUT (DGA, Service Technique des Programmes Aeronautiques, Paris, France) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 6 p. Research supported by DGA, Ministere de la Recherche et de la Technologie, and CNES.

(AIAA PAPER 91-5003) Copyright

A development history and development status evaluation is presented for French R&D efforts toward airbreathing hypersonic propulsion systems for manned vehicles, including single-stage-to-orbit, integrated-scrumjet launch vehicles such as the STAR-H and STS 2000. Attention is given to initial French developmental testing of the Griffon ramjet-powered experimental fighter, the investigation of airframe-propulsion integration, the development of actively cooled structures, and possible structural organization schemes for further work. O.C.

A92-36126

THE ENGINE INSIDE

GUY NORRIS Flight International (ISSN 0015-3710), vol. 141, no. 4314, April 15, 1992, p. 23-27.
Copyright

The GTPC331-500B family of APUs constitutes the largest device of this type in existence; its development has been prompted by the performance requirements of such next-generation commercial aircraft as the B 777, which call for air-starts of such massive ultrahigh-bypass turbofan engines as the GE90. In addition to compressed air for engine starts, this APU will supply electrical and hydraulic power, fuel flow, and cabin air conditioning. The B 777 will mount the unit in its tailcone. Extensive advice was given by airline operators during design development; its choice for the B 777 was based on superior cost and weight performance, relative to competing APUs. O.C.

A92-36889

OPTIMAL MEASUREMENT AND HEALTH INDEX SELECTION FOR GAS TURBINE PERFORMANCE STATUS AND FAULT DIAGNOSIS

A. STAMATIS, K. MATHIOUDAKIS, and K. PAPAILIOU (Athens, National Technical University, Greece) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 209-216. refs
(ASME PAPER 91-GT-294) Copyright

A method for defining the health estimation parameters and the measurements that must be used when a monitoring system for an engine is being set up is presented. The particular engine layout, the available measuring instruments, and the accuracy by which data can be collected are the factors taken into account. The particular health condition estimation factors that have to be used are defined as a function of this information and the desired depth of fault identification. A fast selection procedure based on the method of singular value decomposition is presented. The uncertainty in the estimations is also derived, thus giving an additional element of information useful for decision making. The proposed method, together with adaptive performance modeling, provides a self-sufficient tool, which can be applied for setting up

and subsequent exploitation of a health monitoring expert system. The advantage of the procedure is that it provides a frame of application, allowing quick implementation in a new engine of interest, other than the ones previously considered. Author

A92-39309**ENGINE RELIABILITY**

PETER D. VINALL (Civil Aviation Authority, Gatwick, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 18.1-18.14. Copyright

This report analyzes the reliability of aircraft engines against safety targets set in the context of airworthiness safety goals of the aircraft as a whole. Some examples illustrate experience that has led to changes in certification requirements aimed at attaining higher standards, but which also indicate the inherent difficulties of assuring that available data are correctly interpreted so that such changes do not inadvertently give rise to a reduction in safety. Particular examples are given to illustrate both the degree of past successes and the potential for introducing unintentional traps in the effort to improve the standards in light of experience and advances in design. R.E.P.

A92-40144**REACTIVE MIXING LAYER BETWEEN PRESSURE REFLECTING BOUNDARIES**

J. P. CHOLLET (Grenoble, Institut de Mecanique, France) and R. J. GATHMANN (Grenoble, Institut de Mecanique; SNECMA, Centre de Villaroche, Moissy-Cramayel, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-5-1 to 23-5-6. Research supported by CNRS. refs

Supersonic mixing layers develop instabilities when they are confined between rigid pressure reflecting boundaries. A direct numerical simulation is performed for two- as well as three-dimensional spatial calculations of nonstationary reactive gas flows. Cellular detonation is used as a test case and simulations are calculated for flows between rigid flat plates. Chemical reactions are also considered in order to possibly deal with turbulent combustion in high speed aircraft scramjet engines. Author

A92-40548**VIBRATION ANALYSIS OF GAS TURBINES BY AN INTELLIGENT KNOWLEDGE-BASED SYSTEM**

R. J. ALLWOOD (Loughborough University of Technology, England) and P. I. CHRISTIE (Rolls-Royce, PLC, Bristol, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 115-121. Research supported by ALVEY IT Program. refs Copyright

Monitoring the vibrations of a gas turbine during its development tests requires manual inspection and interpretation of thousands of diagrams displaying measurements made by hundreds of strain gauges and other transducers. This paper describes a prototype knowledge-based computer system to assist in this task. The features on each diagram are located by image processing methods and interpreted by stored knowledge which represents the experience of vibration engineers. The objective of the system is to distinguish the relatively few diagrams which have unusual features from the majority which have only expected features, leaving the interpretation of the unusual diagrams to real experts. The paper gives an overall description of the problem of vibration in gas turbines and some details of the image processing and knowledge processing methods used, and shows some examples of typical diagrams handled by the system. Author

A92-41819**GENERALITIES ON THE RAMJET [GENERALITES SUR LE STATOREACTEUR]**

ROGER MARGUET (ONERA, Chatillon, France) Revue

Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 101-104. In French. Copyright

The general features of the ramjet are briefly reviewed, with emphasis on its basic elements, its propulsion performance, and its utilization characteristics. The evolution of ramjet missions in France since the Second World War is then traced. L.M.

A92-45306**VSTOL ENGINE DESIGN EVOLUTION - GROWTH OF THE PEGASUS ENGINE FOR HARRIER**

A. B. STREET (Rolls-Royce, PLC, Bristol, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. II.3.1-II.3.11. Copyright

The paper traces the evolution of the Pegasus engine since it entered service in 1969 powering the Harrier aircraft. The operational background of the Harrier/AV8 family of aircraft was used to define a demonstrator program primarily aimed at improving performance. This XG15 demonstrator program for the Pegasus 11-61 was successfully completed in 1987 followed by durability demonstrations in early 1988. The results formed the basis of the improved F402-RR-408 engine, offering reduced life cycle costs at higher thrust according to prevailing operational requirements. The main objectives of the XG-15 and 11-61 include the following: 15-percent increase in lift thrusts at 15 C, flat rating of lift thrusts to 32-C conditions, increases in combat thrust at low altitude of at least 20 percent minimal weight increase, double hot end life, and improved modularity and maintainability. The Pegasus 11-61 compressor, combustor, HP turbine, and exhaust system are also discussed. C.A.B.

A92-45317**HOT-GAS REINGESTION - ENGINE RESPONSE CONSIDERATIONS**

D. D. WILLIAMS (Rolls-Royce, PLC, Bristol, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.5.1-III.5.13. Research supported by Ministry of Defence Procurement Executive. refs Copyright

Some of the fundamentals of hot-gas reingestion (HGR) are reviewed in the context of engine stability. Generic time-variant total-temperature distortion descriptors are discussed against a background of external work and of small-and full-scale experience from simulated vertical landings of an augmented Pegasus/Harrier vectored-thrust installation. Results are presented of compression-system-component and overall engine simulations intended to provide guidelines to engine total-temperature distortion sensitivity and stability margin assessment. Total-temperature distortion at engine entry resulting from HGR is found to be highly unsteady due to unsteadiness in the flow upwash field as a result of multiple-jet interactions close to the ground. Repeated tests at correctly simulated aircraft dynamic conditions are needed to establish a proper statistical data base. A methodology for the treatment of the effects of HGR on engine stability is developed. C.A.B.

A92-45321**ASTOVL ENGINE CONTROL**

B. J. QUINN (Rolls-Royce, PLC, Bristol, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.9.1-III.9.6. Copyright

A possible engine control architecture for future ASTOVL aircraft is identified. The ASTOVL engine powerplant control requirements are more complex than those of the Pegasus engine in the Harrier. The concept of an engine feeding a plenum chamber for which mixed (and hot) gases are supplied to both front and back lift nozzles is difficult installationally because of its long hot front duct and potential hot gas ingestion effects. The engine control

07 AIRCRAFT PROPULSION AND POWER

system in this approach is relatively conventional apart from the need to divert gases for either lift or propulsion. The lighter and more integrated engine and aircraft approach using the Pegasus-like configuration is shown to have additional control complexity, but has only relatively small fan surge margin consumption through control effects. C.A.B.

A92-46429

PROPULSION SYSTEM PERFORMANCE AND INTEGRATION FOR HIGH MACH AIR BREATHING FLIGHT

F. A. HEWITT and M. C. JOHNSON (Rolls-Royce, PLC, Bristol, England) IN: High-speed flight propulsion systems. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 101-142. Research supported by ESA. refs
Copyright

Factors involved in the interactions between the intakes, nozzles, and powerplants of high Mach number air-breathing aircraft are discussed. Vehicle dynamic pressure and trajectory, air intake pressure recovery, propulsion from takeoff, burner and nozzle relative scale effects, nozzle area variability, and supersonic combustion are addressed. C.D.

A92-47791

CONCEPT OF A ONE-DIMENSIONAL MODEL OF THE DYNAMIC BEHAVIOR OF A GAS TURBINE [KONCEPCJA JEDNOWYMIAROWEGO MODELU DO BADANIA WLASNOSCI DYNAMICZNYCH TRUBINY GAZOWEJ]

KONRAD SWIRSKI, JANUSZ LEWANDOWSKI, and ANDRZEJ MILLER (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 399-404. In Polish. refs

An approach to the modeling of the dynamic behavior of a gas turbine is proposed whereby the process of working medium accumulation in the flow path of a gas turbine is described in terms of a continuous one-dimensional model. The turbine (compressor) stage is treated as a channel of varying length and cross section. The numerical solution is based on a two-step Lax-Wendroff scheme combined with iterations in the turbine (compressor) sections. V.L.

A92-49115#

THE NUMERICAL SIMULATION OF THE MAIN FUEL CONTROL UNIT OF GAS TURBINE ENGINES

GIOVANNI TORELLA (Italian Air Force Academy, Naples, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 12 p. refs (AIAA PAPER 92-3760) Copyright

A numerical simulation of the main fuel control unit (MFCU) of a gas turbine engine was performed to evaluate the influence of MFCU on the performance and the behavior of the gas turbine engine. Both steady and unsteady engine operations were considered. It is demonstrated that the numerical codes may be used for simulating the MFCU operation and for evaluating control laws necessary for obtaining assigned performance laws. I.S.

A92-53120

SILENT SOLUTIONS

GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 142, no. 4333, Aug. 26-Sept. 1, 1992, p. 23, 26, 27, 30. Copyright

The noise requirements for corporate aircraft fleets are analyzed in terms of solutions providing methodologies for hushkitting and alternative engine technologies. Attention is given to the regulatory distinctions between British aircraft that are qualified as stage-1, -2, and -3 and the associated implications for hushkitting. Engine modifications are set forth which were used by aircraft manufacturers to eliminate extreme noises, and several hushkits are shown to be available for the 727. A 'heavyweight' hushkit is described for the 727-200, and an ejector suppressor is described for the F28 engines of the 1-11 series aircraft. Five hushkits for DC-9s and the hushkits designed for the 737-200 and the F28 are shown to provide the highest level (stage-3) of noise reductions,

although a fuel-burn penalty is predicted for all of the techniques. C.C.S.

A92-54546

CIS ENGINES - THE RANGE REVEALED. II

KEN FULTON Air International (ISSN 0306-5634), vol. 43, no. 2, Aug. 1992, p. 91-96. Copyright

A review is presented of aircraft engines currently in an operational status or under development in the former USSR. Attention is given to the new Soyuz RDK-300-10 single-shaft turbofan design intended for UAVs or as a pylon-mounted takeoff booster for aircraft. A listing is provided of Russian and Ukrainian gas turbine and piston engines that includes basic takeoff thrust and aircraft installations for each of the powerplants. R.E.P.

A92-56281

'A NEW PROPOSAL FOR AN OLD PROBLEM' - THE RIGHT ENGINE FOR THE RIGHT HELICOPTER

A. SPIRKL (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, Germany), W. MUGGLI (MBB GmbH, Munich, Germany), and L. HOLLY (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 18 p.

An overview is presented of the various factors involved in the engine selection process for helicopter development, using the MTR390 turboshaft engine as an example of the procedure. The design is an iterative process between the helicopter and engine manufacturers to derive an optimum overall system. Attention is given to the calculation of operating costs, the influence of the engine on the payload integral, and a summary of evaluation criteria. R.E.P.

N92-11012 University Coll. of North Wales, Bangor.

PARALLEL PROCESSING APPLICATIONS FOR GAS TURBINE ENGINE CONTROL Ph.D. Thesis

HAYDN ASHLEY THOMPSON 1990 275 p
Avail: Univ. Microfilms Order No. BRDX92129

The application of parallel processing to gas turbine control is described. A 3-spool high-bypass gas turbine engine and a controller simulation are written in Occam and mapped onto transputer arrays. These simulations are further complicated with the addition of reheat. A comparison of the same simulations written in C is then performed using the Helios operating system for transputers and the Uniform system upon the Butterfly Plus Computer. These two systems use radically different approaches for interprocessor communication: the transputer using point-to-point serial links and the Butterfly using shared memory. The problems of applying formal methods to parallel asynchronous systems are addressed and the current design specifications are reviewed for their applicability to transputers. Using these specifications, three fault tolerant systems are implemented which address permanent, transient, persistent intermittent and Byzantine failures. A generalized solution to the problem of handling communication failures between the asynchronous transputers using a masking technique is also presented. The fault tolerant systems that are described use a variety of fault tolerant techniques and attempt to exploit the parallelism within the multiprocessor array for a reduction in execution time while simultaneously exploiting the inherent redundancy for fault tolerance. These implementations highlight the current limitations of present transputers and the advantages of the Occam language. Dissert. Abstr.

N92-11015# Cranfield Inst. of Tech., Bedford (England). Dept. of Turbomachinery and Engineering Mechanics.

RADIAL INFLOW TURBINE STUDY Interim Report No. 5, 21 Jan. - 30 Jun. 1991

S. HAMID and R. L. ELDER Jun. 1991 17 p
(Contract DAJA45-89-C-0006)

(AD-A240169; CIT-REF-06/769E(5); R/D-5824-AN-01) Avail: CASI HC A03/MF A01

The radial inflow turbine is a primary component used both in

small gas turbines and turbochargers. Better understanding of the flow processes occurring within the small passages of the machine could well result in the improved design of units. As most of the detailed aerodynamics is still ill-defined, a joint research project with the objective of improving our understanding has been instigated by Cranfield, the U.S. Army and Turbomach (San Diego). This document describes the early attempts at obtaining measurements downstream of the rotor and provides some results. GRA

N92-13938*# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Cincinnati, OH.

RECENT PROGRESS IN INVERSE METHODS IN FRANCE

PIERRE-FRANCOIS BRY (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Cincinnati, OH.), OLIVIER-PIERRE JACQUOTTE (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), and MARIE-CLAIRE LEPAPE (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 123-144 1991

Avail: CASI HC A03/MF A06

Given the current level of jet engine performance, improvement of the various turbomachinery components requires the use of advanced methods in aerodynamics, heat transfer, and aeromechanics. In particular, successful blade design can only be achieved via numerical design methods which make it possible to reach optimized solutions in a much shorter time than ever before. Two design methods which are currently being used throughout the French turbomachinery industry to obtain optimized blade geometries are presented. Examples are presented for compressor and turbine applications. The status of these methods as far as improvement and extension to new fields of applications is also reported. Author

N92-13940*# Centre National de la Recherche Scientifique, Orsay (France).

THE TURBOMACHINE BLADING DESIGN USING S2-S1 APPROACH

T. S. LUU (Centre National de la Recherche Scientifique, Orsay (France).), L. BENCHERIF (Centre National de la Recherche Scientifique, Orsay (France).), B. VINEY (Societe Europeenne de Propulsion, Vernon (France).), and J. M. NGUYEN DUC (Societe Europeenne de Propulsion, Vernon, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 165-176 1991 Sponsored in part by Societe Europeenne de Propulsion

Avail: CASI HC A03/MF A06

The boundary conditions corresponding to the design problem when the blades being simulated by the bound vorticity distribution are presented. The 3D flow is analyzed by the two steps S2 - S1 approach. In the first step, the number of blades is supposed to be infinite, the vortex distribution is transformed into an axisymmetric one, so that the flow field can be analyzed in a meridional plane. The thickness distribution of the blade producing the flow channel striction is taken into account by the modification of metric tensor in the continuity equation. Using the meridional stream function to define the flow field, the mass conservation is satisfied automatically. The governing equation is deduced from the relation between the azimuthal component of the vorticity and the meridional velocity. The value of the azimuthal component of the vorticity is provided by the hub to shroud equilibrium condition. This step leads to the determination of the axisymmetric stream sheets as well as the approximate camber surface of the blade. In the second step, the finite number of blades is taken into account, the inverse problem corresponding to the blade to blade flow confined in each stream sheet is analyzed. The momentum equation implies that the free vortex of the absolute velocity must be tangential to the stream sheet. The governing equation for the blade to blade flow stream function is deduced from this condition. At the beginning, the upper and the lower surfaces of the blades

are created from the camber surface obtained from the first step with the assigned thickness distribution. The bound vorticity distribution and the penetrating flux conservation applied on the presumed blade surface constitute the boundary conditions of the inverse problem. The detection of this flux leads to the rectification of the geometry of the blades. Author

N92-13943*# Skoe (Ivar Helge), Kongsberg (Norway).

A PC-BASED INVERSE DESIGN METHOD FOR RADIAL AND MIXED FLOW TURBOMACHINERY

IVAR HELGE SKOE *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 201-212 1991

Avail: CASI HC A03/MF A06

An Inverse Design Method suitable for radial and mixed flow turbomachinery is presented. The codes are based on the streamline curvature concept; therefore, it is applicable for current personal computers from the 286/287 range. In addition to the imposed aerodynamic constraints, mechanical constraints are imposed during the design process to ensure that the resulting geometry satisfies production consideration and that structural considerations are taken into account. By the use of Bezier Curves in the geometric modeling, the same subroutine is used to prepare input for both aero and structural files since it is important to ensure that the geometric data is identical to both structural analysis and production. To illustrate the method, a mixed flow turbine design is shown. Author

N92-13952*# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

BLADE DESIGN AND ANALYSIS USING A MODIFIED EULER SOLVER

O. LEONARD and R. A. VANDENBRAEMBUSSCHE *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 325-336 1991

Avail: CASI HC A03/MF A06

An iterative method for blade design based on Euler solver and described in an earlier paper is used to design compressor and turbine blades providing shock free transonic flows. The method shows a rapid convergence, and indicates how much the flow is sensitive to small modifications of the blade geometry, that the classical iterative use of analysis methods might not be able to define. The relationship between the required Mach number distribution and the resulting geometry is discussed. Examples show how geometrical constraints imposed upon the blade shape can be respected by using free geometrical parameters or by relaxing the required Mach number distribution. The same code is used both for the design of the required geometry and for the off-design calculations. Examples illustrate the difficulty of designing blade shapes with optimal performance also outside of the design point. Author

N92-13956*# Fiat Aviazione S.p.A., Turin (Italy).

RESEARCH ON INVERSE METHODS AND OPTIMIZATION IN ITALY

FRANCESCO LAROCCA *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 371-390 1991

Avail: CASI HC A03/MF A06

The research activities in Italy on inverse design and optimization are reviewed. The review is focused on aerodynamic aspects in turbomachinery and wing section design. Inverse design of blade rows and ducts of turbomachinery in subsonic and transonic regime are illustrated by the Politecnico di Torino and turbomachinery industry (FIAT AVIO). Author

N92-18728# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.

ADVANCED TACTICAL FIGHTER ENGINE M.S. Thesis

07 AIRCRAFT PROPULSION AND POWER

R. DAVIS Sep. 1990 192 p Sponsored by Ministry of Defence Procurement Executive
(ETN-92-90840) Copyright Avail: CASI HC A09/MF A02

The design of an aeroengine suitable to power the Advanced Tactical Fighter (ATF), a supersonic, long range tactical fighter aircraft being developed in the U.S. is detailed. The specification for a similar long range fighter was used to provide the engine specification. Both turbojet and turbofan cycles were fully investigated at design point, and off design, before selecting the turbofan cycle for further study and optimization. Having optimized the turbofan cycle, the design of the cycle as an aft fan and the design of a conventional turbofan were investigated and the two designs were compared and contrasted. The suitability of the aft fan as a powerplant for the ATF was assessed. ESA

N92-19938# Rolls-Royce Ltd., Derby (England). MATERIALS AND PROCESS DIRECTIONS FOR ADVANCED AERO-ENGINE DESIGN

D. DRIVER 15 Nov. 1990 21 p Presented at the High Temp. Materials for Powder Engineering, Liege, Belgium, 1990 Previously announced in IAA as A91-52506 Submitted for publication
(PNR-90814; ETN-92-90782) Copyright Avail: CASI HC A03/MF A01

A view of future air transport projections is given and how the resulting new aeroengine design will influence materials and processing technology is assessed. Modern military aircraft require gas turbines of mechanically simple design with few highly loaded components operating at high turbine entry temperatures in order to achieve high thrust to weight ratios. For civil aircraft the need for low cost of ownership leads to fuel efficient ultrahigh bypass ratio turbofan engines with relatively low purchase and maintenance costs and with extended component life reliability. The associated demands in materials technology are for high specific strength and stiffness, increased temperature capability and for manufacturing processes which enable components with tailored microstructures and properties to be made in a consistent and cost effective manner. The trend towards 'designer materials' is already being demonstrated with single crystal technology and with thermomechanically and powder processed components, but future demands will require a move from monolithic materials to more complex metal matrix, intermetallic, glass and ceramic composite structures, often involving manufacturing routes where the material and the component are made in the same processing operation. ESA

N92-19939# Rolls-Royce Ltd., Derby (England). Civil Powerplant Technology Div.

RE-ENGINEING APPEARS TO OFFER BEST PAYBACK FOR YOUNG: CHAPTER 2 COMPLIANT AIRCRAFT

M. J. T. SMITH 15 Nov. 1990 4 p Previously announced in IAA as A91-29053 Repr. from ICAO Journal, Nov. 1990 p 12-14
(PNR-90848; ETN-92-90798) Copyright Avail: CASI HC A01/MF A01

As a result of aircraft noise regulations, Chapter 2 compliant aircraft are faced with the prospect of enforced retirement by around the year 2000, and a tougher action at airports even earlier. The options for the older aircraft owner are in increasing order of cost: to do nothing, operating where the aircraft is acceptable for as long as possible, and then scrapping it (this is the obvious course of action with very old airframe); where technically possible to risk getting by with a bolt on hushkit, and then operating until further local noise constraints force scrapping; to reengine with a modern turbofan and, as a result, have an environmentally acceptable and valuable airframe as an asset (this option is attractive to owners of young airframes); to sell the aircraft while it still has resale value, and by a much more expensive replacement. The pros and cons of the 'hushkit' and 're-engine' options are considered. The re-engining option appears the most advantageous, having a whole array of benefits besides outstanding noise reduction, the hushkitting offering little real noise alleviation, especially at take off. ESA

N92-20179# Rolls-Royce Ltd., Derby (England). USE OF CFD IN THE DESIGN OF A MODERN MULTISTAGE AERO ENGINE LP TURBINE DESIGN

C. T. J. SCRIVENER, C. F. CONNOLLY, J. C. COX, and G. M. DAILEY 1 Apr. 1991 11 p
(PNR-90862; ETN-92-90851) Copyright Avail: CASI HC A03/MF A01

Modern civil aeroengines require turbomachinery components of the highest possible efficiency. Furthermore the blading must be simultaneously designed for minimum cost and weight whilst remaining consistent with the highest possible durability. Satisfying all these requirements culminates in a component offering a competitive advantage to the customer. The role of three dimensional viscous computational fluid dynamics methods in the design of a modern multistage LP turbine is described. These methods have now advanced to the state where they can be used during the design iteration to determine the aerofoil geometry. Technical issues addressed by these methods include separation bubbles, aerofoil stack and lean for optimum performance, flow deviation, incidence sensitivity and the control of secondary flows. ESA

N92-20459# Rolls-Royce Ltd., Derby (England). Airworthiness Services Div.

ETOPS: A DEVELOPING SCENE

D. W. ALLARD 17 Apr. 1991 18 p
(PNR-90844; ETN-92-90794) Copyright Avail: CASI HC A03/MF A01

Extended Range Twin Engine Operations (ETOPS) is concerned with the operations of twin-engine commercial transport aircraft that are more than 60 minutes of single engine flying time from a suitable airfield. The history of ETOPS is traced; the current scene is described; and the next stage in the development of ETOPS is investigated. Bias is given towards engine/powerplant reliability in the ETOPS scenario, although, it is recognized that the reliability of the total aircraft system must be considered. ESA

N92-20573# Rolls-Royce Ltd., Leavesden (England). APPLICATION OF A WATER DROPLET TRAJECTORY PREDICTION CODE TO THE DESIGN OF INLET PARTICLE SEPARATOR ANTI-ICING SYSTEMS

D. L. MANN (Rolls-Royce Ltd., Leavesden (England).) and S. C. TAN (Cranfield Inst. of Tech., Bedford, England) 1 Nov. 1990 11 p Sponsored in part by Ministry of Defence
(PNR-90839; ETN-92-90792) Copyright Avail: CASI HC A03/MF A01

A dust particle trajectory code is considered. Recent work on the code is described. This includes an ice accretion prediction model suitable for use as a design aid for a wide variety of gas turbine engine inlets, but particularly for particle separator geometries. The calculation of the local heat transfer coefficient is seen to be critical to the success of the ice accretion prediction. The incorporation of a suitable model is described and it is shown that a series of validation tests, carried out on a full scale rig satisfactorily verified the code. A second series of validation experiments, carried out in an icing facility, further shows the prediction model to be appropriate. ESA

N92-21740# Rolls-Royce Ltd., Derby (England). Combustion Dept.

EMISSIONS FROM AIRCRAFT: STANDARDS AND POTENTIAL FOR IMPROVEMENT

D. M. SNAPE and M. T. METCALFE 1 Aug. 1990 11 p Presented at the International Symposium on Freight Transport and Environment, Schereningen, Fed. Republic of Germany, 3-5 Jul. 1990
(PNR-90768; ETN-92-90760) Copyright Avail: CASI HC A03/MF A01

Types of exhaust emissions produced by aircraft gas turbine engines are considered and an attempt to put these into context in both global and local airport terms with particular emphasis on freight transport is made. The basic operation of the gas turbine combustor and the need to maintain a high standard of

airworthiness is discussed and the various techniques which are used to bring about emissions reductions are described. This leads into consideration of the likely trends in emission from aircraft sources as air traffic growth occurs and discussion of the need for future technological development to bring out emissions reductions. The various levels and types of technology which are associated with differing emission reductions are considered.

ESA

N92-21848# Rolls-Royce Ltd., Derby (England).

COMPRESSING THE COMPRESSOR

R. J. HILL, D. J. NICHOLAS, and H. TUBBS 1 Nov. 1990
22 p Presented at the Dr. D. M. Smith Memorial Lecture IMechE,
10 Apr. 1990

(PNR-90824; ETN-92-90786) Copyright Avail: CASI HC
A03/MF A01

The development of the axial flow compressor from its conception to how it is today is outlined giving special attention to aerodynamic developments, materials used and mechanical design. The use of computers to model the aerodynamics and mechanical behavior is discussed and future trends are considered.

ESA

N92-21850# Rolls-Royce Ltd., Derby (England).

THE EVOLUTION OF THE BYPASS ENGINE

G. M. LEWIS 15 Nov. 1990 11 p

(PNR-90832; ETN-92-90788) Copyright Avail: CASI HC
A03/MF A01

The evolution of the bypass engine starting from Whittle's ducted fan patented in 1936 is described and illustrated. Throughout the evolution of the bypass engine, the basic principles and most of the relevant design configurations have been those which were established by the pioneers of jet propulsion. Progress in the civil field was contingent upon the advances in aerodynamic design to produce high efficiency single stage fans, high duty and hence short HP compressors, high temperature turbines and low drag nacelles and installations. These advances progressively reduced the mechanical design problems of concentric rotors, shafts and bearings, and enabled basically simple engines to be designed with acceptable mass. The development of fighter engines, although not directed specifically towards increased bypass ratio, contributed to the resources to evolve the advanced technologies required. Throughout the history of aviation the contribution of fighter engine development to the advance of civil engines has been evident and this will continue in the generation of advanced core technology. In the future the continuing divergence of design configuration between the civil and military engine will necessitate substantial research and development funding for the particular features of the new generation of civil engines. The future of world fuel prices and availability, and the economics of air transport systems will determine the level of investment and the pace of future progress towards the engine concepts that were identified about 40 years ago.

ESA

N92-22098# Rolls-Royce Ltd., Derby (England).

IMPACT OF REGULATION CHANGES ON ENGINE DESIGN AND CERTIFICATION

C. G. CANT 1 Nov. 1990 16 p

(PNR-90789; ETN-92-90843) Copyright Avail: CASI HC
A03/MF A01

Some changes to the airworthiness regulations can have a major effect on the engine manufacturer. An example of such an effect was the enforced cessation of Civil Spey engine new production resulting from the introduction of the FAR Part 36 Stage 3 Noise rule. The resultant evolution of the Tay engine, initially conceived to power the Fokker F100 aircraft is traced and some of the design features and resulting engine certification test aspects are described.

ESA

N92-22406# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

AIRCRAFT GAS TURBINE EMISSIONS: THEIR NATURE, TECHNOLOGY FOR REDUCTION, AND A POLLUTION COMPARISON WITH CHANNEL TUNNEL TRANSPORT M.S. Thesis

P. J. HEARD 1990 237 p Sponsored by Ministry of Defence
Prepared in cooperation with Royal Air Force Coll., Cranwell,
England

(ETN-92-91056) Copyright Avail: CASI HC A11/MF A03

The techniques and technologies involved in reducing exhaust emission levels from aircraft gas turbine engines are examined and current pollution levels are compared with other modes of transport. The nature of gas turbine emissions and the available technology for reducing emission levels are discussed. A pollution comparison in traveling from London to Paris by air and via the Channel Tunnel is made. The first two routes compared were by air and by the through train from Waterloo to Paris (Gare du Nord Station); both of these routes offer journey times of approximately three hours and would therefore compete for a similar market. The entire rail network will be electrified between the two capitals, and hence the power station emissions produced in providing the energy to move the trains was included. With the exception of sulphur dioxide emissions (produced from power stations), the emissions per passenger in traveling by train are substantially lower than going by air. To complete the study, a third route was examined. This route is by petrol vehicle utilizing the Tunnel Shuttle. Comparisons of the emissions per passenger illustrated that travelling by car is the most damaging form of transport in terms of effect on the environment.

ESA

N92-24336#

Von Karman Inst. for Fluid Dynamics,
Rhode-Saint-Genese (Belgium).

BOUNDARY LAYERS IN TURBOMACHINES

1991 496 p Lecture series held in Rhode-Saint-Genese, Belgium,
2-6 Sep. 1991

(ISSN 0377-8312)

(VKI-LS-1991-06; ETN-92-91262) Avail: CASI HC A21/MF A04

An overview of the latest progress made in the understanding of turbomachinery flows is presented. Special emphasis is put on the phenomenon of boundary layer transition. Both experimental and numerical aspects of the problem are considered. A basic description of the fundamental aspects of boundary layers and transition as applied to turbomachinery flows is given. The experimental identification of different flow phenomena within boundary layers and the correct design and exploitation of such experiments are reported. The development of boundary layers along concave surfaces is studied. The modeling of the transition zone in a boundary layer is presented. The unsteady aspects of boundary layers and transition are considered. The present status of numerical modeling of turbomachinery boundary layer flows is dealt with.

ESA

N92-27039# Rolls-Royce Ltd., Bristol (England).

VSTOL ENGINE DESIGN EVOLUTION: GROWTH OF THE PEGASUS ENGINE FOR HARRIER

A. B. STREET 1 Nov. 1990 12 p

(PNR-90805; ETN-92-90775) Copyright Avail: CASI HC
A03/MF A01

The Pegasus engine entered service in 1969 powering the Harrier aircraft and has been progressively developed. The operational background of the Harrier/AV8 family of aircraft was used to define a demonstrator program primarily aimed at improving performance. The XG15 demonstrator program for the Pegasus 11-61 was successfully completed in 1987 followed by durability demonstration in early 1988. The results formed the basis of the improved F402-RR-408 engine offering reduced life cycle costs at higher thrust according to prevailing operational requirements. The production engine validation test program commenced with an engine roll out in Jun. 1988, flight testing commencing at Bristol (United Kingdom) one year later with completion due in May 1990

07 AIRCRAFT PROPULSION AND POWER

at the same time as commencement of production engine delivery. A summary of the program and technical arisings is given. ESA

N92-27040# Rolls-Royce Ltd., Bristol (England).

ASTOVL ENGINE CONTROL

B. J. QUINN 1 Nov. 1990 7 p

(PNR-90808; ETN-92-90777) Copyright Avail: CASI HC A02/MF A01

The future Advanced Short Take Off and Vertical Landing (ASTOVL) aircraft will probably require good supersonic capability and combine the attributes of the F16 aircraft with those of the Harrier, and the engine will undoubtedly be placed at the back of the aircraft. Thus the front lift nozzles mounted forward of the aircraft center of gravity, will require long ducts from the engine. To minimize hot gas injection effects and the weight of the ducting to the front lift nozzles, it is proposed that fan delivery air should be used directly. This introduces the need for a dual cycle engine configuration, unmixed for lift, mixed for propulsion, and thus for movable blocker doors to ensure that only lift or propulsive nozzles are selected. However, during mode change it is probable that fan running line control will be necessary to minimize potential surge or flutter problems. Further, the much larger separation between the front and back lift nozzles will generate potentially large pitching moments during engine modulation at various landing weights for which back lift nozzle area variation is a possible solution. Clearly control is thus becoming more sophisticated than on Harrier/Pegasus, and has certainly generated the need for extensive aircraft/engine integration studies. A possible control architecture is identified, and it is concluded that this approach is reasonable. ESA

N92-27041# Rolls-Royce Ltd., Derby (England).

ASTOVL PROPULSION SYSTEMS: CONFIGURATION AND CONCEPT CHOICE

N. A. MITCHELL 1 Nov. 1990 11 p Sponsored in part by Ministry of Defence

(PNR-90809; ETN-92-90778) Copyright Avail: CASI HC A03/MF A01

A wide variety of Advanced Short Takeoff and Vertical Landing (aircraft) (ASTOVL) propulsion concepts were studied against a number of different customer requirements including NST6464. These studies are reviewed with particular reference to those aspects which affect concept choice and the quality of the overall system. Once these studies were complete, a reexamination of the principal attributes of a STOVL aircraft was carried out by visiting Harrier operations on deployment both on land and at sea. This together with the results of the full scale landing simulations of an ASTOVL aircraft led to the evolution of a propulsion system for supersonic STOVL aircraft. The key elements of this propulsion system are that in the STOVL regime the propulsion system is unmixed and has the characteristics of the Pegasus (i.e., cool front jets and full nozzle vectoring) but is a mixed flow afterburning turbofan in the flight regime. The critical technologies for this propulsion system are identified and the programs required to underwrite them are outlined. The major characteristics of this propulsion system are compared with other systems and those elements which contribute to a low risk propulsion system are identified. ESA

N92-27062# Royal Aircraft Establishment, Farnborough (England).

THE CHANGING ROLE OF EXPERIMENTATION IN AEROENGINE R AND D: THE POINT OF VIEW OF THE RESEARCH WORKER

J. DUNHAM Nov. 1991 19 p

(AD-A246372; RAE-TM-P-1216; DRIC-BR-307984) Avail: CASI HC A03/MF A01

The pioneers of the gas turbine based their components designs on simple mathematical models which employed many empirical factors. They conducted two types of experiment: Trials of engines and components, to develop their mechanical integrity and endurance, and to improve their performance and stability (development tests), and Parametric experiments on simplified

components or simulated component geometries, to evolve better models and to generate empirical correlations of component behavior (research tests). Fifty years later, the same need for development tests remains, but as design methods have evolved from simple empirical models to complex computational fluid dynamics (CFD) models, the nature of research tests has changed. There is still a need for experiments aimed at evolving better mathematical models, but the empiricism is at a more detailed level (such as transition prediction) and so are the experiments. But component testing has moved away from a parameter variation to tests aimed at the development and verification of better CFD models. Meanwhile, instrumentation techniques have also improved a great deal, enabling more accurate and detailed measurements. GRA

N92-27422# Rolls-Royce Ltd., Bristol (England).

THERMALLY SPRAYED COATING SYSTEMS FOR SURFACE PROTECTION AND CLEARANCE CONTROL APPLICATIONS IN AERO ENGINES

T. N. RHYS-JONES 1 Apr. 1990 15 p Repr. from Surface and Coatings Technology, v. 43/44, 1990 p 402-415

(PNR-90802; ETN-92-90845) Copyright Avail: CASI HC A03/MF A01

The principal current and new thermal spray coating processes used for compressor, combustion chamber and turbine applications in aircraft engines are described with particular reference to high velocity combustion and plasma spraying techniques. The uses of coatings for wear and erosion resistance, oxidation and corrosion control, thermal barrier applications and gas path sealing (clearance) are discussed. ESA

N92-27462# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

VALIDATION OF A CANARI CODE BY THE COMPUTATION OF THREE DIMENSIONAL TURBULENT FLOW IN TURBINE VALVE [VALIDATION DU CODE CANARI PAR LE CALCUL DE L'ECOLEMENT TRIDIMENSIONNEL TURBULENT DANS UN DISTRIBUTEUR DE TURBINE]

BEATRICE ESCANDE and LAURENT CAMBIER In AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992 In FRENCH; ENGLISH summary

Copyright Avail: CASI HC A02/MF A06

The preliminary results are presented which were obtained in order to validate the CANARI code in a turbomachinery case. This code solves the Reynolds averaged compressible three dimensional Navier-Stokes equations. It is applied to the flow computation through a high pressure turbine annular cascade. This computation is characterized by the use of a highly stretched O mesh around the blades and of H meshes for the upstream and downstream regions, in order to allow an accurate description of the leading edge and trailing edge phenomena. The configuration studied is an experimental set-up which has been recently realized at ONERA for the validation of computational codes. Author

N92-27463# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany).

COMPUTATION AND VISUALIZATION OF SPECIFIC FLOW PHENOMENA IN TURBOMACHINERY APPLICATION

J. HAARMEYER and B. STUBERT In AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992

Copyright Avail: CASI HC A02/MF A06

Capacity and speeds in industrial computer hardware allows the complete numerical evaluation of the three dimensional flow field through turbomachinery blading. Detailed consideration of specific flow phenomena like horseshoe vortex or tip clearance effects is of increasing importance in the engine design process. The large amount of data produced by a 3-D calculation requires separate development of algorithms for visualization of the computational results. Numerical techniques for the integration of both streamlines and vortex lines through 3-D vector fields are needed to identify fluid flow features based on values at discrete grid points. Such an integrated technique is covered and also

includes a search algorithm for places of local rotations. Some evaluations of Euler calculations in a turbomachinery application are shown. Author

N92-27464# Vrije Univ., Brussels (Belgium). Computational Fluid Dynamics Group.

AN INTEGRATED CFD SYSTEM FOR 3D TURBOMACHINERY APPLICATIONS

C. HIRSCH, C. LACOR, C. DENER, and D. VUCINIC /n AGARD, CFD Techniques for Propulsion Applications 15 p Feb. 1992 Copyright Avail: CASI HC A03/MF A06

A complete CFD system, composed of an interactive mesh generator, an efficient flow solver and an advanced, portable, flow visualization system is presented for turbomachinery applications. The mesh generator (IGG) and the visualization system (CFView) have the same user interface and call on Object Oriented Programming on top of X Windows. The flow solver is developed within a multigrid method, where the time integration schemes are considered as 'smoothers'. Both explicit or implicit time integration methods can be chosen. The explicit integration is based on the Runge-Kutta method and the implicit solver uses relaxation methods with Gauss-Seidel point or line strategies. The space discretization allows for central as well as upwind schemes and algebraic or two equation turbulence models are available. The application to an annular turbine blade row is shown. Author

N92-27466# Royal Aerospace Establishment, Farnborough (England).

PREDICTIONS AND MEASUREMENTS OF 3D VISCOUS FLOW IN A TRANSONIC TURBINE NOZZLE GUIDE VANE ROW

G. C. HORTON, S. P. HARASGAMA, and K. S. CHANA /n AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Previously announced as N92-14319 Copyright Avail: CASI HC A03/MF A06

A transonic turbine nozzle guide vane was tested in an annular cascade with two different endwall geometries. The measurements were taken at engine representative flow conditions and include surface static pressures and a downstream area traverse of total pressure. The flow through these geometries was modeled at the test conditions using a three dimensional viscous flow program. The effects of different mesh densities and two turbulence models were studied. Predictions of secondary flow and loss were obtained and are compared with the experimental measurements. The different turbulence models were found to have little effect in the predicted overall loss though there were differences in the distribution and the shape of the vane wakes. The one equation turbulence model produced wakes which had similar levels of total pressure deficit to the experiment and had a more similar shape than those with the Baldwin-Lomax algebraic model. Author

N92-27469# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

STEADY AND UNSTEADY 3D FLOW COMPUTATION THROUGH A TRANSONIC TURBINE STAGE [CALCULS 3D STATIONNAIRE ET INSTATIONNAIRE DANS UN ETAGE DE TURBINE TRANSSONIQUE]

ALAIN LEMEUR /n AGARD, CFD Techniques for Propulsion Applications 24 p Feb. 1992 In FRENCH; ENGLISH summary Copyright Avail: CASI HC A03/MF A06

The following problems are discussed. The best approach in order to obtain the average characteristics of the flow field by directly using a three dimensional computation on a complete turbomachinery stage. The real flow is absolutely 3-D and unsteady. This implies that numerical simulation of the flow must be unsteady. Therefore, it is necessary to make more or less rigorous unsteady computation or averaged steady computation can be directly performed. Two different ways to carry out computation on a highly loaded turbine stage are given and analyzed. The steady approach in which the average flow is redistributed at each iteration between both rows, in order to obtain the average steady solution. And the unsteady approach by taking into account several channels on both rows. The computation is purely unsteady with a time periodicity; i.e., if a result is obtained at time t , the same results

must be found at time $t + T$, T being the time period. In these cases, a time average must be made over a period in order to obtain the 3-D flow field average. Author

N92-27484# Rolls-Royce Ltd., Bristol (England). Combustion Technology Dept.

MODELLING THE VAPORISER AND PRIMARY ZONE FLOWS FOR A MODERN GAS TURBINE COMBUSTION CHAMBER

N. R. BOND, J. M. LEVALLOIS, and K. R. MENZIES /n AGARD, CFD Techniques for Propulsion Applications 18 p Feb. 1992 Copyright Avail: CASI HC A03/MF A06

A three dimensional curvilinear finite volume computational fluid dynamics (CFD) code has been applied to aid understanding of the mechanisms leading to observed baseline temperature patterns on a modern vaporizer combustion chamber. This code calculates recirculating, turbulent, combustor flows with a k-epsilon turbulence model and a conserved scalar/local chemical equilibrium combustion model. Predictions were obtained for both the vaporizer internal flows and for the complete flametube; the latter used the predicted vaporizer exit flow patterns as boundary conditions. The vaporizer flow models displayed a sensitivity to the fuel injector location which was subsequently confirmed by water analogy experiments. In conjunction with the flametube calculations, the effect of injector geometry and location on the primary zone flow patterns and temperatures were assessed, explaining the experimental results. The computational studies suggested a modified fuel injector geometry to reduce sensitivity and improve fuel distribution, which was validated by subsequent experiments in the full combustor. Author

N92-28073# Cranfield Inst. of Tech., Bedford (England). Dept. of Turbomachinery and Engineering Mechanics.

RADIAL INFLOW TURBINE STUDY Interim Report No. 6, 1 Jun. - 31 Dec. 1991

S. HAMI and R. L. ELDER Dec. 1991 12 p (Contract DAJA45-89-C-0006) (AD-A246938; R/D-5824-AN-01) Avail: CASI HC A03/MF A01

The radial inflow turbine is a primary component used both in small gas turbines and turbochargers. Better understanding of the flow processes occurring within the small passages of the machine could result in the improved design of units. As most of the detailed aerodynamics is still ill-defined, a joint research project with the objective of improving our understanding was carried out. This document gives the sixth report on the project. It describes progress and measurements taken downstream of the rotor. GRA

N92-28458# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.

STEADY AND TRANSIENT PERFORMANCE PREDICTION OF GAS TURBINE ENGINES [PREDICTION DES PERFORMANCES DES MOTEURS A TURBINE A GAZ EN REGIMES ETABLI ET TRANSITOIRE]

May 1992 189 p Lectures held in Cambridge, MA, 27-28 May 1992, in Neubiberg, Fed. Republic of Germany, 9-10 Jun. 1992, and in Chatillon/Bagneux, France, 11-12 Jun. 1992 (AGARD-LS-183; ISBN-92-835-0674-X; AD-A253824) Copyright Avail: CASI HC A09/MF A02

Aero-thermodynamic performance prediction methods for gas turbine engines with respect to steady and transient operation are discussed. This includes advanced cycle calculation methods, also taking into account variable cycle engine types. A very important objective is the consideration of installation effects, i.e., Reynolds number and inlet distortions, as well as advanced control concepts for increasing engine surge margins. In addition to these topics, individual papers include practical considerations in designing the engine cycle, dynamic simulation, inlet distortion effects in aircraft propulsion system integration, 'smart' engines, and performance and health monitoring models.

07 AIRCRAFT PROPULSION AND POWER

N92-28460# Royal Aerospace Establishment, Farnborough (England). Air Vehicle Performance Dept.

PRACTICAL CONSIDERATIONS IN DESIGNING THE ENGINE CYCLE

M. G. PHILPOT *In* AGARD, Steady and Transient Performance Prediction of Gas Turbine Engines 24 p May 1992 Sponsored by Ministry of Defence

Copyright Avail: CASI HC A03/MF A02

To define the cycle parameters and calculate the performance of a real engine, numerous practical constraints need to be taken into account. These fall into two main categories: the limitations of available component technologies; and the operational considerations that are dependent on aircraft application. The main technology limiters are discussed. How they are incorporated into the cycle definition process is indicated. Operational factors include the extent of the intended flight envelope and the range of the critical flight conditions for which performance must be assured, and the balance to be struck between minimizing fuel consumption, maximizing installed power, and constraining costs of ownership. Taking these technology and operational influences into account, the basic cycle characteristics and approach to cycle choice are examined for three main classes of aircraft: subsonic transports, military combat aircraft, and helicopters. Author

N92-28461# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Engineering Div.

STEADY AND TRANSIENT PERFORMANCE CALCULATION METHOD FOR PREDICTION, ANALYSIS, AND IDENTIFICATION

JEAN PIERRE DUPONCHEL, JEAN LOISY, and RENE CARRILLO *In* AGARD, Steady and Transient Performance Prediction of Gas Turbine Engines 21 p May 1992

Copyright Avail: CASI HC A03/MF A02

The detailed design and development of turbofans involves the prediction and identification, by means of test analysis, of the performance of the engine and its components. The thermodynamic simulation and analysis codes integrate existing knowledge and interpretations of the detailed operating procedure of the components of the engine being developed. The relevance of the predicted performance depends on the quality of the representation of the various physical phenomena affecting the characteristics of the components and, consequently, on the incorporation of experimental correlation in the modelling. In this context, the representation of compressor and turbine characteristics is particularly important. We will analyze the ability of corrected parameters to represent MACH similitude at the component inlet under various conditions. Author

N92-28464*# Cambridge Univ. (England).

INLET DISTORTION EFFECTS IN AIRCRAFT PROPULSION SYSTEM INTEGRATION

J. P. LONGLEY (Cambridge Univ. (England).) and E. M. GREITZER (Massachusetts Inst. of Tech., Cambridge.) *In* AGARD, Steady and Transient Performance Prediction of Gas Turbine Engines 18 p May 1992 Sponsored by NASA. Lewis Research Center; GE; and Rolls-Royce Ltd.

Copyright Avail: CASI HC A03/MF A02

A tutorial survey of inlet flow distortion effects on engine performance and stability is presented. Inlet distortions in aero engines arise through a variety of causes. They can be essentially steady, due to non-axisymmetric intake duct geometry, or time varying, for example from flow separation off the lip of the inlet during maneuvers or shock-induced separation during supersonic flight. Whatever the cause, the result is generally a decrease in performance and, more importantly, a lessening of the stable flow range of the compressor. The distortions are generally three-dimensional. It is an extremely useful simplification to break them, at least conceptually, into radial and circumferential non-uniformities and approach each separately. Purely radial distortions can be treated by the methods that were developed for designing compressors in nominally axisymmetric inlet flow, and this type of distortion will be only briefly discussed. Circumferential non-uniformities, however, introduce additional fluid

dynamic features into the analysis of compressor behavior and often have the larger impact on performance and stability. Thus we concentrate mainly on the effects of steady circumferential inlet flow distortion. Author

N92-28465# Technische Univ., Munich (Germany). Performance Dept.

CALCULATION OF INSTALLATION EFFECTS WITHIN PERFORMANCE COMPUTER PROGRAMS

J. KURZKE *In* AGARD, Steady and Transient Performance Prediction of Gas Turbine Engines 19 p May 1992

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Gas turbine engine components, such as compressors, burners, and turbines are usually tested on rigs prior to installation into an engine. In the engine, the component behavior is different for a variety of reasons. The installation effects are caused by small geometrical differences due to nonrepresentative rig operating temperatures and pressures, by different gas properties and Reynolds numbers and by radial as well as circumferential temperature and pressure profiles at the inlet to the component. For highly accurate performance predictions these rig-to-engine effects are taken into account. Traditionally the term 'installation' is also used for describing all the differences in engine operation and behavior between testbed and aircraft. Intake and afterbody drag, power offtake and bleed, as well as intake pressure losses and inlet flow distortion have significant impact on airflow, thrust, specific fuel consumption, and compressor stability. Using modern performance synthesis programs all these effects can be simulated. Author

N92-33645# Technische Univ., Brunswick (Germany). Fakultät fuer Maschinenbau und Elektrotechnik.

A MULTIVARIABLE CONTROL CONCEPT FOR A GAS TURBINE ENGINE Ph.D. Thesis [MEHRGROSSEN-REGELUNGSKONZEPT FÜR EIN GASTURBINENTRIEBWERK]

HARALD SOELTER 1991 169 p In GERMAN

(ETN-92-92104) Avail: CASI HC A08/MF A02

An alternative control concept is presented for LARZAC 04 type gas turbine. It is shown that a possible way to systematize the design process is to use concepts of methodical projects from adjacent fields. The gas turbine engine process and the detailed control requirements are examined. The engine control system, theoretical linear engine control concepts, and examples for control systems for similar complex processes are analyzed. The obtained results lead to the formulation of a control structure, which is based on an adaptive anticipated control in connection with a multivariable control, which is used to maintain the state of the process in the allowed operating range, even in the case of disturbances or parameter divergences. ESA

N92-33748# Rolls-Royce Ltd., Derby (England).

RE-ENGINEING FOR REAL STAGE 3 COMPLIANCE Progress Report

K. GODDARD and M. R. SELLAR 4 May 1992 15 p Presented at the Aircraft Noise Attenuation and Regulatory Update, Miami, FL, 3-5 Apr. 1991

(PNR-90872; ETN-92-92183) Copyright Avail: CASI HC A03/MF A01

Noise legislation developments relevant to noisy stage 2 aircraft are described, and reengineering for noise reduction to stage 3 compliance is discussed. The Rolls Royce Tay engine is addressed, and Tay 650 design features and noise reductions are described. The status of current programs for the BAC1-11-2400, B727-1000, and Tay 670, is outlined. The current business scene, aircraft resale values, and lease rates, are discussed. ESA

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A92-11561

VSTOL AIRCRAFT FLIGHT CONTROL SYSTEM DESIGN USING H(INFINITY) CONTROLLERS AND A SWITCHING STRATEGY

R. A. HYDE and K. GLOVER (Cambridge, University, England) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2975-2980. refs Copyright

The problem of designing controllers for plants with widely varying dynamics over the required operating envelopes is addressed. The plant investigated is a generic VSTOL (vertical/short takeoff and landing) aircraft model (GVAM). The approach taken is to switch between linear controllers designed on linearizations of the nonlinear model. The linear designs make use of an open-loop singular value shaping technique which optimizes the system robustness to perturbations of the normalized coprime factors of the plant. Switching between controllers is achieved using a technique which enables smooth transition between controllers. It is concluded that the proposed loop-shaping approach has produced robust closed-loops, giving the necessary performance capability. I.E.

A92-11595

AN ASSESSMENT OF ROBUSTNESS OF VARIABLE STRUCTURE CONTROL SYSTEMS FOR ADVANCED AIRCRAFT MANOEUVRES

S. K. SPURGEON (Loughborough University of Technology, England) and R. J. PATTON (York, University, England) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3588-3593. refs Copyright

The authors use a model-following VSCS (variable structure control system) design approach to provide an aircraft control system which exhibits parameter insensitivity with good disturbance rejection while enabling the pilot to perform an advanced aircraft maneuver. Eigenstructure assignment is used to define a model with these response characteristics. The authors also consider a definition and practical measures of the robustness of such a model-following VSCS. The VSCS technique is illustrated by considering the design of a lateral translational/yaw pointing control scheme for a conventional combat aircraft which has been augmented with a chin-fin to provide the required sideforce control. Analysis of the performance of this control scheme when subjected to a range of flight conditions is used to demonstrate application of the robustness criteria developed. I.E.

A92-13199

THE AERODYNAMIC INTERFERENCE BETWEEN A FLAPPED TANKER AIRCRAFT AND A RECEIVER AIRCRAFT DURING AIR-TO-AIR REFUELLING

A. W. BLOY, V. TROCHALIDIS, and M. G. WEST (Manchester, Victoria University, England) Aeronautical Journal (ISSN 0001-9240), vol. 95, Oct. 1991, p. 274-282. Research supported by Ministry of Defence of England and SERC. refs Copyright

Wind-tunnel data are obtained from a model of a flapped tanker wing and receiver aircraft at varying vertical separation and the results compared with theory. In the model, the tanker wing is represented by a pair of horseshoe vortices from the wing and flap tips and an allowance is made for the self-induced vertical displacement of the trailing vortices at the receiver aircraft position. The aerodynamic loads on the receiver are determined by the

vortex-lattice method and lifting-line theory, although an approximate method is used for the side force on the fin. Data were obtained from open and closed test sections in order to estimate the wind-tunnel boundary-interference effect. In the longitudinal case, significant differences were obtained between theory and experiment. Two reasons for the differences are the assumption that the trailing vortices are fully rolled up and the neglect of viscous decay of the vortices. The theoretical and experimental trends are similar although the theory overpredicts the rolling moment due to bank and sideways displacement while the corresponding side force and yawing moment are underpredicted. Author

A92-16079

AIRCRAFT GROUND VIBRATION TEST BY MEANS OF FLIGHT CONTROL SURFACES

A. GRAVELLE, M. LEPART, and P. LUBRINA (ONERA, Chatillon, France) (International Forum on Aeroelasticity and Structural Dynamics, Aachen, Federal Republic of Germany, June 3-6, 1991) ONERA, TP no. 1991-96, 1991, 7 p. refs (ONERA, TP NO. 1991-96)

A complete modal identification method using aircraft flight control surfaces as exciters has been implemented. The excitation signals applied to several control surfaces are coherent sweep frequency signals. The measurements of the strain on the actuators shafts are used to determine the introduced forces allowing to derive the generalized masses. The method was applied first to a numerical model of a fighter aircraft, then a comparative ground vibration test of a MIRAGE 2000 aircraft has been performed by means of both the classical appropriation method and the present control surfaces excitation method. The consistency of the results obtained with the two methods is satisfactory and the control surface excitation method seems promising as far as the adaptation of the excitation can be realized for the different mode shapes. Author

A92-16621

DELIVERED WITH FEELING

HARRY HOPKINS Flight International (ISSN 0015-3710), vol. 140, Nov. 20, 1991, p. 31, 35, 38. Copyright

An overview is presented of the Boeing 777 primary flight control system which is based on a triplex system of primary flight computers, with data flows on three independent but identical channels - right, center, and left. The flight control system is designed to retain pilot awareness through tactile means, by back-driving controls and throttle, while retaining some speed/pitch stability. R.E.P.

A92-29094

MEETING VSTOL AIRCRAFT PERFORMANCE REQUIREMENTS USING SCHEDULED H(INFINITY) CONTROLLERS

R. A. HYDE and K. GLOVER (Cambridge, University, England) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 577-582. Research supported by SERC. refs Copyright

Meeting required handling qualities for VSTOL aircraft using H(infinity) robust control design techniques is discussed. The key characteristic of VSTOL aircraft is widely varying dynamics across the flight envelope. The controller must not only have good robust stability to these changing dynamics, but also exhibit good robust performance so that handling qualities are met at all operating conditions. An approach for meeting these design aims is presented. The method consists of performing linear H(infinity)-optimal designs at a set of operating points, and then scheduling the controllers using linear interpolation of the gains. An exact observer representation of the controller is used to interpolate the gains. I.E.

A92-35769

GENERALIZED HIGHER HARMONIC CONTROL - TEN YEARS OF AEROSPATIALE EXPERIENCE

MICHEL POLYCHRONIADIS (Aerospatiale, Division Helicopteres, Marignane, France) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 10 p. Research supported by Service Technique des Programmes Aeronautiques, DRET, and Direction Generale de l'Aviation Civile. refs

An overview of Aerospatiale's investigations in the field of rotor active control technology by higher harmonic blade pitch control is presented, with emphasis on vibration reduction, rotor noise reduction, and performance improvement by stall alleviation. In the case of vibration reduction, the successful development of a closed-loop system tested on the SA349 experimental Gazelle in 1985 is traced, as well as work performed since then: flight tests with blades equipped with pressure transducers and design studies on a production system for the future NH90 helicopter. The reduction of blade vortex interaction noise was demonstrated in flight on the SA349 helicopter with an open-loop higher harmonic control system. Attention is also given to the optimum rotor control concept, where an integrated system equipped with different sensors determines in real time the blade pitch control ideally adapted to the flight configuration. P.D.

A92-36990

AIRCRAFT CONTROL FOR TAKE-OFF IN WINDSHEAR

VEIJO KAITALA (Helsinki University of Technology, Espoo, Finland), GEORGE LEITMANN, and SANDEEP PANDEY (California, University, Berkeley) Dynamics and Control (ISSN 0925-4668), vol. 1, no. 3, Sept. 1991, p. 239-252. Research supported by Academy of Finland, Finnair, and USAF. refs (Contract NSF ECS-86-02524) Copyright

The controlled take-off of an aircraft flying through an unavoidable windshear is studied. The purpose of the guidance is to guarantee aircraft take-off without crash; no other performance criteria are applied. The proposed aircraft take-off control scheme consists of a memoryless state-feedback control strategy for a class of continuous-time aircraft models including unpredictable but bounded windshear. The design of the take-off control scheme is carried out by applying a theory of deterministic control of uncertain systems. The time or the place of encountering a windshear is not known but, according to the basic assumption, the upper bound of the uncertainty - here the maximum rate of the change of the wind velocity - is assumed to be known. Such knowledge allows one to design a deterministic controller to stabilize the relative path inclination of the aircraft. Author

A92-39908

DESIGN OF LOW-SENSITIVITY MODALIZED OBSERVERS USING LEFT EIGENSTRUCTURE ASSIGNMENT

S. P. BURROWS and R. J. PATTON (York, University, England) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 779-782. refs Copyright

A multiple objective optimization technique is applied to the design of modalized observers. The modalized observer was introduced by Andry et al. (1984) and involves the choice of closed-loop observer left eigenvectors so that the effect of a known mismatch of initial conditions between the observer and plant is minimized. Such mismatches occur, for example, in flight control problems when the aircraft (in a straight and level flight condition) is subject to a gust disturbance that introduces nonzero values to the angle-of-attack and/or sideslip variables. The multiple objective approach involves the optimization of a multicriterion cost function that takes account of both eigenvalue sensitivity and of estimator error caused by an initial condition mismatch. This approach involves the selection of a fixed set of closed-loop observer eigenvalues. The corresponding assignable eigenvector subspaces are then calculated. A slight modification to this approach is applied here to the problem of aircraft gust alleviation. S.A.V.

A92-40039

RAE BEDFORD VAAC RESEARCH PROJECT

B. SINGER (Defence Research Agency, Bedford, England) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 190-209. refs Copyright

The VSTOL aircraft advanced flight control (VAAC) project of research into advanced short-takeoff/vertical-landing (ASTOVL) flight control is presented. This project is focused around the VAAC Harrier which is configured as a flexible inflight VSTOL research simulator for design of control strategies to ensure that the pilot can utilize the aircraft's complete performance potential safely and with maximum operational effectiveness. Consideration is given to ASTOVL concepts, VAAC aims and objectives, a description of the VAAC Harrier XW 175 test vehicle, and the VAAC digital Harrier clearance program. R.E.P.

A92-45319

A PROGRESS REPORT ON ASTOVL CONTROL CONCEPT STUDIES UNDER THE VAAC PROGRAMME

O. P. NICHOLAS (Royal Aerospace Establishment, Bedford, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.7.1-III.7.14. refs Copyright

A paper by Nicholas (1987) about the ASTOVL control concept studies under the VAAC program is updated. The experimental flight control system fitted to the VAAC aircraft is described. A broad spectrum of potential STOVL control concepts under consideration is outlined, with emphasis on the longitudinal plane. Attention is given to three broad longitudinal plane control concepts for the STOVL regime: three inceptors controlling pitch, thrust magnitude, and thrust direction; three inceptors controlling pitch, normal thrust component, and longitudinal thrust component; and two inceptors controlling total (aerodynamic plus thrust) normal force and total longitudinal force, with pitch responding as necessary to provide this. It is planned to apply increasing effort to the development of displays to match the characteristics of the different longitudinal control concepts and also to control in the lateral/directional sense. C.A.B.

A92-45322

INTEGRATED FLIGHT CONTROL SYSTEMS - ARCHITECTURAL CONSIDERATIONS FOR FUTURE AIRCRAFT CONCEPTS

RICHARD B. SMITH (GEC Avionics, Ltd., Rochester, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.10.1-III.10.12. Copyright

The current generation of automatic flight control systems technology is reviewed in relation to the developing operational and logistical requirements, particularly for single crew air superiority vehicles. It is proposed that the requirements for reduced pilot workload and a mean time between mandatory maintenance specification will be met by an integrated vehicle management system concept. The design drivers involved in the development of an integrated approach to automatic vehicle management are reviewed in the context of the overall size and complexity of the task for ASTOVL aircraft. Consideration is given to the issues involved in interfunctional cooperation, system availability and integrity, and weight minimization. A control strategy for integrated flight and propulsion control is outlined. An architectural concept to meet extended off-base availability requirements without first line maintenance intervention is quantitatively justified. A candidate integrated vehicle management system architecture is proposed, and recommendations for the development of the technologies essential to its creation are advanced. C.A.B.

A92-46765

HANG-GLIDER RESPONSE TO ATMOSPHERIC INPUTS

GUIDO DE MATTEIS (Roma I, Università, Rome, Italy) Journal

of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 4, July-Aug. 1992, p. 1048-1050. refs
Copyright

Hang-glider flight in a turbulent atmosphere is presently considered in a framework where, in analogy for conventional aircraft, hang-glider response to atmospheric inputs is characterized in terms of gust-transfer functions and the power spectral densities of the output. Attention is given to longitudinal motion; the gust transfer functions of the longitudinal state variables and of the load factor are determined, and the effects of approximations connected with the modeling of the inputs are discussed in light of characteristic frequencies for the glider in cruise conditions.

O.C.

A92-47777

MATHEMATICAL MODELING OF THE FLIGHT OF PASSENGER AIRCRAFT IN THE CASE OF ENGINE FAILURE [MODELOWANIE MATEMATYCZNE LOTU SAMOLOTU PASAZERSKEGO W STANACH AWARII SILNIKOW]

REALY FLOUTI and JERZY MARYNIAK (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 135-141. In Polish. refs

The effects of engine failure and fuselage deformation on the flight dynamics of a passenger aircraft with tail-mounted engines are examined, with the IL-62M aircraft used as an example. In the analysis, the aircraft is treated as a rigid body with six degrees of freedom, with allowance for the possibility of the flexural deformation of the tail section. The equations of aircraft motion are derived using Boltzmann-Hamel equations for mechanical systems with holonomic constraints. The motion of the aircraft in the case of engine failure is simulated numerically using fifth- and sixth-order Runge-Kutta-Verner methods. Results of calculations are presented in graphic form.

V.L.

A92-47779

CALCULATION OF THE AERODYNAMIC DERIVATIVES OF AIRCRAFT IN THE SUPERSONIC REGION USING THE MACH BOX METHOD [OBLICZANIE POCHODNYCH AERODYNAMICZNYCH SAMOLOTU W ZAKRESIE NADDZWIEKOWYM PRZY ZASTOSOWANIU METODY 'PUDELEK MACHA']

TOMASZ GOETZENDORF-GRABOWSKI (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 151-157. In Polish. refs

Physical and mathematical models are presented which describe the motion of an aircraft in steady supersonic potential flow of a gas. A numerical method for calculating the aerodynamic parameters is proposed which is referred to as the Mach box method. Results of calculations are presented.

V.L.

A92-47783

MODELING OF THE CONTROL SYSTEMS OF ROTARY WING AIRCRAFT (REVIEW) [MODELOWANIE UKLADOW STEROWANIA WIROPLATOW (REFERAT PRZEGLADOWY)]

WIESLAW LUCJANEK and JANUSZ MARKIEWICZ (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 243-249. In Polish. refs

Methods for controlling the flight of rotary wing aircraft are discussed, as are physical models used for the analysis of flight control systems. In particular, attention is given to some new approaches to rotary wing aircraft control, such as higher harmonic control, individual blade control, fly by wire control, side stick control, voice control, and pilot head movement control. Schemes of tilt rotor control and control mechanisms used in helicopter and airplane mode flights are shown.

V.L.

A92-47784

MATHEMATICAL MODELING OF THE EFFECT OF WINDSHEAR ON THE DYNAMICS OF A LANDING AIRCRAFT [MODELOWANIE MATEMATYCZNE WPPLYWU ZMIENNEGO RUCHU POWIETRZA NA DYNAMIKE LADUJACEGO SAMOLOTU]

JERZY MARYNIAK and JIMOH PEDRO (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 257-264. In Polish. refs

The dynamic characteristics of a multiple-engine aircraft during an approach to landing are modeled mathematically. A complete set of nonlinear equations of motion is derived for the aircraft, with three-dimensional variable wind and windshear terms included. Changes of the aerodynamic coefficients due to windshear are computed on the basis of quasi-steady aerodynamics.

V.L.

A92-47785

AIRCRAFT STABILIZATION AT LARGE ANGLES OF ATTACK [STABILIZACJA SAMOLOTU NA DUZYCH KATACH NATARCIA]

WIESLAW J. J. MICHALSKI and MARIA ZLOCKA (Warsaw University of Technology, Poland) Politechnika Slaska, Zeszyty Naukowe, Mechanika (ISSN 0434-0817), no. 107, 1992, p. 283-290. In Polish. refs

Based on physical and mathematical modeling, a system of nonlinear equations of motion is obtained for a rigid aircraft with six degrees of freedom. For steady straight horizontal flight at large angles of attack, an optimal control law is synthesized for a quadratic quality criterion. It is shown that the required flight conditions can be maintained using active control based on a certain law. Results of a numerical simulation of the motion of an actively controlled aircraft are presented.

V.L.

A92-48496

ROBUSTNESS CHARACTERISTICS OF FAST-SAMPLING DIGITAL PI CONTROLLERS FOR HIGH-PERFORMANCE AIRCRAFT WITH IMPAIRED CONTROL SURFACES

B. PORTER (Salford, University, England) IN: NAECON 91; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 553-563. refs

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The robustness characteristics of fast-sampling error-actuated digital set-point tracking PI controllers are established in the case of partially irregular linear multivariable plants. It is shown that the plant-parameter variations tolerable by such fast-sampling error-actuated digital controllers can be expressed very simply in terms of the step-response matrices of the nominal and actual plants. These general results are illustrated by examining the robustness characteristics of a fast-sampling error-actuated digital PI controller for the F-16 aircraft in case the flaperon and elevator suffer various losses in effectiveness.

I.E.

A92-48608

ADVANCES IN AIRCRAFT MODAL IDENTIFICATION [PROGRES EN IDENTIFICATION MODALE DES AVIONS]

ALAIN GRAVELLE (ONERA, Direction Scientifique des Structures, Chatillon, France) (Entretiens Science et Defense 1992, Paris, France, May 12, 13, 1992) ONERA, TP no. 1992-47, 1992, 11 p. In French. refs

(ONERA, TP NO. 1992-47)

The modal identification of aircraft structures is conducted by ground vibration tests employing the modal adaptation technique. The efficiency of this technique can be enhanced by introducing methods that aid in performing the adaptation, utilizing a modal isolation criterion resulting in a simpler procedure to drive the tests. Association with the use of multidegree-of-freedom identification algorithms would introduce some tolerance in connection with the adaptation deviations, which makes it possible to account for modal couplings.

R.E.P.

A92-49326

FLIGHT MANAGEMENT SYSTEM BACK-UP NAVIGATION FOR THE A330/A340 AIRCRAFT

HENRI GRIGUIERE (Honeywell, Inc., Air Transport Div., Blagnac, France) IN: IEEE/AIAA Digital Avionics Systems Conference, 10th, Los Angeles, CA, Oct. 14-17, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 482-486.

Copyright

The author presents the architecture and functional operation of the multi-purpose control display unit (MCDU) back-up navigation used on the A330/A340 MCDU aircraft. Its purpose and capability in playing a key role on the A330/A340 for providing navigational back-up and equipment redundancy are explored. The A330/A340 flight management system is embedded in two flight management and guidance and envelope computers (FMGECs) and the triple redundant MCDU. At any one time two of the MCDUs are used to interface with the two FMGECs. The third MCDU can be switched into either position in case of an MCDU failure. In addition, two of the MCDUs have the capability to provide back-up navigation in case of loss of the FM function from the FMGECs. I.E.

A92-50008

DEVELOPMENT OF ACTIVE CONTROL TECHNOLOGY FOR THE NEXT GENERATION OF COMBAT AIRCRAFT

R. N. LEE (British Aerospace /Military Aircraft/, Ltd., Preston, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 206, no. G1, 1992, p. 15-25.

Copyright

In the mid 1970s British Aerospace recognized that active control technology offered considerable benefits in terms of improved performance and combat effectiveness for future combat aircraft. However, the introduction of such technology carried with it a significant development risk. In order to minimize that risk, a series of flight demonstrator programs were initiated. This paper describes the principles of active control and the very successful fly-by-wire Jaguar and experimental aircraft demonstrator flight test programs which progressively demonstrated the viability and benefits of active controls to the extent that this technology is being fully utilized on the new European fighter aircraft. Author

A92-50503

ROBUST FLIGHT CONTROL SYSTEMS - A PARAMETER SPACE DESIGN

ALBERTO CAVALLI, GIUSEPPE DE MARIA (Napoli, Università, Naples, Italy), and LEOPOLDO VERDE (Centro Italiano Ricerche Aerospaziali, Capua, Italy) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 5, Sept.-Oct. 1992, p. 1207-1215. Previously announced in STAR as N91-15718. refs

Copyright

Generally, high performance requirements in terms of better efficiency (reduction in fuel consumption) and maneuverability, impose intrinsic instability on the aircraft. Then a Stability Augmentation System is required for its stabilization. Moreover, the aircraft must be safely controllable without any exceptional piloting skill. The requirements of stability and control are referred in literature as handling qualities. According to handling quality specifications, a feedback controller must be designed with robustness criteria with respect to flight conditions and sensor failure. A new design procedure of feedback controllers which allows the achievement of simultaneous stabilization, and provides some kind of fault tolerance with respect to sensor failure, are proposed. An application to the F4-E military aircraft is also presented. Author

A92-55172#

A SIMULATOR EVALUATION OF VARIOUS MANUAL CONTROL CONCEPTS FOR FLY-BY-WIRE TRANSPORT AIRCRAFT

P. J. VAN DER GEEST, A. M. H. NIEUWPOORT, and J. BORGER (Fokker Aircraft, Schiphol, Netherlands) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug.

10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 181-191. refs (AIAA PAPER 92-4328) Copyright

Results are presented of an evaluation, on a fixed base simulator, of three control concepts based on different design philosophies, applied to a FBW-controlled Fokker 100 aircraft: a rate command system, a flight path vector command system, and a C* command system. The control laws of the three concepts were designed to provide Level 1 short-term responses in both pitch and roll. Results of tests indicate that, in general, the performance (in terms of flight path accuracy) could not be significantly improved in comparison to the conventional Fokker 100, especially when Flight Director System is available. Advantages of FBW-control concepts primarily show up in terms of reduced workload and enhanced safety during manual flight. It is suggested that a flight path vector command concept may provide significant operational, and associated economic, benefits for short-haul aircraft. I.S.

A92-55332#

ATTAS FLIGHT TEST AND SIMULATION RESULTS OF THE ADVANCED GUST MANAGEMENT SYSTEM LARS

K.-U. HAHN and R. KOENIG (DLR, Institut fuer Flugmechanik, Braunschweig, Germany) IN: AIAA Atmospheric Flight Mechanics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 58-70. refs

(AIAA PAPER 92-4343) Copyright

Design and development of a new load alleviation and ride smoothing (LARS) system is reviewed with particular attention given to simulation results and flight test analyses. The system is capable of effective gust alleviation related to rigid body and elastic mode responses. The system was tested using the DLR Advanced Technologies Testing Aircraft System (ATTAS). It is concluded that lift control leads to substantial suppressions of wind induced normal accelerations, more precise flight path control, and reduced pilot workload. Aircraft response in the longitudinal direction can be improved by a combination of lift and drag control devices. Flight control systems with small overall time delays should be used to perform the control of structural modes. O.G.

A92-56283

TRIMMING ROTOR BLADES WITH PERIODICALLY DEFLECTING TRAILING EDGE FLAPS

Y. K. YILLIKCI (Ministry of National Defence, Undersecretariat for Defence Industries, Ankara, Turkey) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 12 p. refs

A simplified trimming process for rotors with periodic trailing edge flap motions is developed. In this process, first collective and cyclic pitch control inputs are calculated by the use of standard helicopter trim equations. At the second stage, pitch motions are replaced with periodic trailing edge flap (TEF) motions represented up to the first harmonics. For the TEF case only rigid collective and pretwist angles are retained. The trailing edge flap motion harmonics are calculated based on the idea that TEF control must achieve identical trust harmonics of the pitch control case. Sample results for a small remotely controlled helicopter configuration with trailing edge flaps controls are presented. Different flap geometries are investigated and ETF concept is evaluated. Author

A92-56308

BLADE INSTABILITY OF HORIZONTALLY STOPPABLE ROTORS

U. ARNOLD (Braunschweig, Technical University, Germany) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 16 p. refs

One important source for instability of stopped rotors during the decelerating and accelerating process is investigated. Flapping stability is usually lost at advance ratios above two, due to strong parameter excitation through periodic aerodynamic forces. The differential equation of motion is derived for the common rigid blade approximation, considering the spring restrained hinge with arbitrary hinge offset. Reverse flow, which is shown to be decisive

for the stability boundaries, is included analytically in a straightforward way. The effect of the parameter excitation is discussed on the basis of Mathieu- and Hill-type differential equations. Simple stability criteria derived from Strutt's stability diagram are compared with the computed eigenvalues using Floquet theory. The effect of the forcing function, i.e., the amplitude amplification of the inhomogeneous equation, is shown to be even more important than stability. The possibility of suppressing divergent flap oscillations by applying high rotor deceleration and acceleration rates is discussed. C.A.B.

A92-56334

A STUDY OF HELICOPTER ROTOR/FUSELAGE RESPONSE IN LOW-SPEED MANOEUVRES - COMPARISON OF THEORY WITH FLIGHT

A. T. MCCALLUM (Defence Research Agency, Aerospace Div., Bedford, United Kingdom) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 30 p. refs
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Comparisons have been made of the behavior of a rigid blade rotor simulation model with data gathered on a Puma helicopter during quick-hop maneuvers as part of a validation study. Two validation techniques are investigated; the first method involves driving a full helicopter simulation model with pilot controls, whilst the second involves driving an isolated rotor model with rotor controls and fuselage motions. Relative merits of each method are discussed and, in the case of the quick-hop maneuver, the advantages of using the latter method, called open loop simulation, are demonstrated. Inflow dynamics and nonlinear section aerodynamics are briefly discussed and preliminary results illustrating the effects of these modelling features presented. It is concluded that the method of driving open loop simulation is ideal for validating and understanding rotor behaviour and will be investigated for a broader range of flight conditions and rotor system types. Author

N92-12004# Royal Aerospace Establishment, Bedford (England).

APPLICATION OF EIGENSTRUCTURE ASSIGNMENT TO THE CONTROL OF POWERED LIFT COMBAT AIRCRAFT

P. R. SMITH 19 Feb. 1991 304 p
(RAE-TM-FS-1009; BR302867; ETN-91-90294) Copyright Avail: CASI HC A14/MF A03

An examination of the eigenstructure assignment control law design technique, and its application to both a vectored thrust aircraft, and a helicopter example is reported. In reviewing the design method, new insight is shed upon the role of the left eigenvectors, which are shown to determine the nature of the input coupling into a dynamic system. It is concluded that selection of the right eigenvectors alone, as is often shown in the literature, is insufficient to ensure decoupling in the system response. Examination of the frequency domain characteristics of a helicopter example are considered, which allow the controlled aircraft handling qualities to be determined. It is shown that simple dynamic elements in the command path can be used to tune the response when problems in obtaining a sufficiently high bandwidth are encountered. It is concluded that the method provides a viable approach to aircraft control law design, a chief attraction being the very simple structure of the resulting control laws. ESA

N92-15072# Technische Univ., Brunswick (Germany). Fakultät fuer Maschinenbau und Elektrotechnik.

PROJECT OF AN ADAPTIVE MULTIAXIAL AUTOPILOT WITH LEARNING PILOT CONTROL Ph.D. Thesis [ENTWURF EINES SELBSTEINSTELLENDEN MEHRACHSIGEN FLUGREGLERS MIT LERNENDER VORSTEUERUNG]

ULRICH LINDEMANN 1991 116 p In GERMAN
(ETN-92-90592) Avail: CASI HC A06/MF A02

The autopilot was implemented in the form of several computing programs in the digital computer of research aircraft. It was successfully tested in flight trial. The coefficients of a discrete model transfer function were identified from the dynamic behavior of the aircraft. The identification assessed the relation between

the autocorrelation of the test signal and the cross correlation of test signal and aircraft behavior. This process proved efficient. A universal applicable software package was developed during the flight trial of the autopilot, which allowed for the testing of control algorithms in real time conditions in the aircraft. ESA

N92-18294# Manchester Univ. (England). Aeronautical Engineering Group.

MODEL PARAMETER IDENTIFICATION TECHNIQUES FOR FLIGHT FLUTTER TESTING

J. E. COOPER 1991 30 p Presented at 71st AGARD Structures and Materials Panel, Povo de Varzin, Portugal, 8-10 Oct. 1990 (AERO-REPT-9105; ETN-92-90936) Avail: CASI HC A03/MF A01

The most popular modal parameter identification techniques and the comparative exercises involving them are reviewed. A survey of the application of such methods in flight flutter tests is undertaken. A survey and some form of round robin procedure are deemed necessary in order to establish the effective use of system identification techniques for flight flutter testing. ESA

N92-18321# Manchester Univ. (England). Aeronautical Engineering Group.

AIRCRAFT AERODYNAMICS AND STABILITY AND CONTROL DURING AIR-TO-AIR REFUELING Ph.D. Thesis

VASSILIOS TROCHALIDIS May 1990 140 p Sponsored by Science Research Council and Ministry of Defence
(AERO-REPT-9017; ETN-92-90940) Avail: CASI HC A07/MF A02

A study aimed at the development of an analytical model capable of representing any combination of tanker and receiver aircraft in an Air to Air Refueling (AAR) configuration is presented. A theoretical analysis of the problem with requirements for theoretical models is given. Individual theories such as lifting line, horseshoe vortex, and vortex lattice method are given. Combination models are discussed. The experimental hardware and software is described. Experimental tests are described and measurements are plotted and compared with theoretical predictions. The longitudinal aerodynamic interference between large receiver and radar aircraft during AAR is addressed. Results from an investigation into the lateral aerodynamics and stability and control of a VC10/Hercules tanker/receiver combination are presented. ESA

N92-18793# Royal Aerospace Establishment, Farnborough (England). Aerodynamics Dept.

DYNAMIC WIND TUNNEL TESTS ON CONTROL OF FOREBODY VORTICES WITH SUCTION

A. JEAN ROSS, E. B. JEFFERIES, and GERALDINE F. EDWARDS In AGARD, Manoeuvring Aerodynamics 12 p Nov. 1991

Copyright Avail: CASI HC A03/MF A03

Extensive static and dynamic experiments were made in low speed wind tunnels to investigate the possibility of using the yawing moment due to asymmetric forebody vortices for control at high angles of attack. The relative positions of the two vortices arising near the nose apex can be changed by applying differential suction through two small holes very near the tip. The resulting forces and moments measured in static tests were analyzed for the effects of forebody diameter and slenderness ratio. The Royal Aeronautical Establishment (RAE) High Incidence Research Model was controlled successfully on a free-to-yaw rig, indicating that the system could be used in flight. However, it could be expected that there are significant lags in the generation of the aerodynamic forces and moments. Experiments were conducted on a simple missile model mounted on a string rig, to measure the responses in yawing moment and sideforce due to sinusoidal variation over a range of frequencies of flow rates through suction holes. The implications of these results for the proposed free-flight model tests are discussed. Author

N92-18795# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

AEROSERVOELASTIC STABILITY OF AIRCRAFT AT HIGH INCIDENCE

JUERGEN BECKER *In* AGARD, Manoeuvring Aerodynamics 20 p Nov. 1991

Copyright Avail: CASI HC A03/MF A03

The aeroservoelastic stability of a fighter type aircraft is investigated at high angle of attack. The effects of nonlinear, incidence dependent unsteady aerodynamic forces of elastic modes and of control surface deflections on the structural coupling are demonstrated for low and high subsonic speeds for different incidences. The difference of open loop frequency response functions calculated with linear and with high angle of attack unsteady aerodynamics documents the necessity of the introduction of high incidence effects for aeroservoelastic stability calculations. Nonlinear effects are introduced using unsteady pressures of wind tunnel experiments on an oscillating model by correction of theoretical pressures. Author

N92-19295# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Automatique.

DOUBLE LOOP CONTROL LAW STRATEGY AND APPLICATIONS TO HELICOPTER Interim Report [STRATEGIE DE LOI DE COMMANDE A 2 BOUCLES ET APPLICATIONS A L'HELICOPTERE. RAPPORT INTERMEDIAIRE]

CHRISTIANE SAMBLANCAT, JEAN-FRANCOIS MAGNI, PIERRE APKARIAN, and PHILIPPE MOUYON Mar. 1991 81 p *In* FRENCH

(Contract DRET-89-002-36-1-3-4)

(CERT-2/7724-DERA; ETN-92-90871) Avail: CASI HC A05/MF A01

A double loop command rule strategy using placement structure and H infinity synthesis is described. Transitory placement is treated by means of placement modes while the robustness and the permanent regime are considered via H infinity synthesis. The advantages of the method are illustrated through helicopter piloting, which is a practical problem involving movement uncoupling specifications as well as robustness in terms of the rotor dynamics which are not taken into consideration. ESA

N92-19621 Oxford Univ. (England).

ROBUST CONTROL SYSTEM DESIGN WITH APPLICATION TO HIGH PERFORMANCE HELICOPTERS Ph.D. Thesis

MICHAEL STANLEY TOMBS 1987 225 p

Avail: Univ. Microfilms Order No. BRD-93833

One of the first applications of H-infinity optimization to the design of controllers for industrial problems is presented. The system considered was an unstable helicopter model, obtained from a larger nonlinear simulation configured to represent future high performance helicopters. The problem was to design a full authority flight control system, to stabilize the aircraft and decouple the controlled inputs, thus reducing pilot workload. Robustness was a primary issue because of model uncertainty, particularly due to the omission from the design model of higher order rotor dynamics. The optimization problem was based on the minimization of sensitivity (for performance) and control output (for robustness) transfer functions. Simple weighting functions were found to be useful for examining the fundamental performance versus robustness tradeoff, and to be more effective at shaping the closed loop transfer functions than LQG/LTR techniques. An important improvement to the H-infinity optimization solution process was the development of a numerically reliable algorithm to perform minimal realization. Dissert. Abstr.

N92-20026# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel Working Group 9.

VALIDATION OF FLIGHT CRITICAL CONTROL SYSTEMS

GORDON BELCHER, ed., DUNCAN E. MCIVER, ed., and KENNETH J. SZALAI, ed. Dec. 1991 136 p

(AGARD-AR-274; ISBN-92-835-0650-2; AD-A247742) Copyright Avail: CASI HC A07/MF A02

The objectives of the research is the following: (1) to provide guidance to those concerned in the Flight Critical Control System (FCCS) validation, namely systems designers and certification authorities; and (2) to identify the areas of research which need to be explored to enable validation of the next generation of FCCS. An attempt was made to review all flight critical control system validation activities which had been completed or were under active consideration, in Europe and the U.S. Author

N92-20475# National Aerospace Lab., Amsterdam (Netherlands). Aeroelasticity Div.

INVESTIGATION OF A SEMI-EMPIRICAL METHOD TO PREDICT LIMIT CYCLE OSCILLATIONS OF MODERN FIGHTER AIRCRAFT

J. J. MEIJER and R. J. ZWAAN 23 Mar. 1990 29 p Presented at the AGARD Specialists Meeting on Aircraft Dynamic Loads Due to Flow Separation, Sorrento, Italy, 1-6 Apr. 1990 (NLR-TP-90087-U; ETN-92-90965; AD-B158646L) Avail: CASI HC A03/MF A01

Requirements of modern fighter aircraft to operate with high maneuverability in the transonic speed regime may lead under certain conditions to Limit Cycle Oscillations (LCO), produced by a structural/aerodynamic interaction. Conditions of transonic LCO are moderate angle of attack and Mach numbers ranging from 0.9 to 1.1. An analysis of steady wind tunnel data, obtained for a fighter type aircraft in a typical configuration indicated that shock induced separation plays a dominant role. A semi empirical prediction method which makes use of these steady data is presented and some results are shown. Possibilities to extend the method to the use of unsteady wind tunnel data are discussed. ESA

N92-23238# British Aerospace Public Ltd. Co., Bristol (England). Airbus Div.

SIMULTANEOUS STRESS AND FLUTTER OPTIMIZATION FOR THE WING OF A TRANSPORT AIRCRAFT EQUIPPED WITH FOUR ENGINES

J. M. D. SNEE (British Aerospace Aircraft Group, Bristol (England).), H. ZIMMERMANN (Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.)), D. SCHIERENBECK (Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.)), and P. HEINZE (Deutsche Airbus G.m.b.H., Bremen, Germany, F.R.) *In* AGARD, Integrated Design Analysis and Optimisation of Aircraft Structures 12 p Feb. 1992 Copyright Avail: CASI HC A03/MF A03

The main objective of this work is to demonstrate the benefits of interdisciplinary optimization techniques to a modern aircraft design. The optimization is related to a four engine transport aircraft series equipped with a common wing. The series comprises of two aircraft differing in fuselage length by approximately 4 m but with the same maximum takeoff weight. Wing commonality in terms of optimization means that all the significant aeroelastic and static constraints are taken into account in order to achieve a weight optimized but also valid design proposal. In effect, this means that critical flutter situations of both aircraft types dependent on the fuel and load conditions as well as the dimensioning static load cases in combination with the stresses allowable must be introduced into a mathematical optimization model and the weight optimized solution must be sought with the aid of various optimization techniques. Author

N92-27958# National Aerospace Lab., Amsterdam (Netherlands).

DEVELOPMENT OF A METHOD TO PREDICT TRANSONIC LIMIT CYCLE OSCILLATION CHARACTERISTICS OF FIGHTER AIRCRAFT

J. J. MEIJER (National Aerospace Lab., Amsterdam (Netherlands).) and A. M. CUNNINGHAM, JR. (General Dynamics Corp., Fort Worth, TX.) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 21 p Mar. 1992 Sponsored in part by AF and General Dynamics Corp. (Contract NIVR-07801-N)

Copyright Avail: CASI HC A03/MF A04

An analysis of steady wind tunnel data obtained for a fighter

type aircraft indicated that shock-induced and trailing edge separation plays a dominant role in the development of Limit Cycle Oscillations (LCO) at transonic speeds. On this basis, a semi-empirical LCO prediction method is being developed which makes use of such steady wind tunnel data. The preliminary method was applied to several configurations and correctly identified those which have encountered LCO. The method has the potential for application early in the design process of new aircraft to determine and understand these nonlinear aeroelastic characteristics. The method is still being evaluated, and upgrading and refinements are expected from unsteady wind tunnel force and pressure measurements to be obtained from oscillating models as part of an extensive investigation into the aerodynamic nature of LCO. The method is described in its present form and the results of the latest predictions are compared with flight results and used to further assess various parametric effects. Author

N92-28652# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

SOME LONGITUDINAL HANDLING QUALITIES DESIGN GUIDELINES FOR ACTIVE CONTROL TECHNOLOGY TRANSPORT AIRCRAFT

W. P. DEBOER (Office National d'Etudes et de Recherches Aérospatiales, Paris (France)), H. T. HUYNH (Office National d'Etudes et de Recherches Aérospatiales, Paris, France), O. P. NICHOLAS (Royal Aerospace Establishment, Farnborough, England), D. SCHAFFRANEK (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.), and J. A. J. VANENGELEN 11 May 1990 21 p (NLR-TP-90129-U; GARTEUR/TP-056; ETN-92-91435) Avail: CASI HC A03/MF A01

The main conclusions and recommendations from extensive work performed by the Flight Mechanics Action Group on handling qualities (FM/AG01) of the Group for Aeronautical Research and Technology in Europe (GARTEUR) are presented. The work of this AG, which involved cooperation between research institutes of France, Germany, the United Kingdom, and the Netherlands, was performed with the ultimate aim of establishing handling qualities guidelines for future transport aircraft with advanced flight control and display system. The work of the AG started with the consultation of aircraft industries within the participating countries concerning their opinion on anticipated manual control aspects for future transport aircraft. The underlying report may be regarded as the overall result of the work performed on the basis of this consultation, which resulted in a number of handling qualities guidelines. ESA

N92-28653# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

RESPONSE OF HELICOPTERS TO GUSTS

R. NOBACK 27 Apr. 1990 98 p (Contract RNLA-FB-KLU-1990/A.5) (NLR-TP-90159-U; ETN-92-91436) Avail: CASI HC A05/MF A02

Equations to describe the response of helicopters to atmospheric gusts are derived. Results of calculations are compared to results as presented in the literature. The influence of various parameters is investigated, especially that of a mass parameter. Special attention is paid to the response to continuous sinusoidal turbulence. ESA

N92-32750# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

NLR INVESTIGATIONS OF FLUTTER BEHAVIOUR OF FIGHTER AIRCRAFT WITH EXTERNAL STORES

J. J. MEIJER 29 Apr. 1991 26 p Presented at the International Aerospace Congress, Melbourne, Australia, 12-16 May 1991 (NLR-TP-91134-U; ETN-92-91999) Avail: CASI HC A03/MF A01

The state of the art in flutter-stability prediction of fighter aircraft with external stores is discussed. Available computer software, measuring equipment and techniques, and other means and devices useful in flutter clearance activities are covered. Some past F-16 clearance activities are presented. Special attention is

devoted to the flutter stability investigation of the transonic speed regime, which assists in the development and validation of new prediction methods. ESA

N92-32780 ESDU International Ltd., London (England).

A BACKGROUND TO THE HANDLING QUALITIES OF AIRCRAFT

Mar. 1992 28 p

(ISSN 0141-3988)

(ESDU-92006; ISBN-0-85679-811-8) Avail: ESDU

ESDU 92006 examines those factors that affect the ease and safety with which an aircraft may be flown. For consideration of aircraft handling, aircraft are divided by class or role indicating the primary purpose of the operation of the aircraft. Within each class, flight or sorties are subdivided by flight phase which describes the type of tasks to be completed. A discussion of piloting techniques and the development of pilot opinion ratings, including the Cooper-Harper ratings, precedes an examination according to the mode of motion (short period, phugoid, roll, spiral or Dutch roll) of the primary parameters that characterize the handling qualities criteria. Extracts from current UK Design and Airworthiness Requirements for Services Aircraft then cover the required flying qualities according to aircraft class and flight phase that define the acceptable characteristics for the control feel in longitudinal maneuvering flight and for the response in the five modes of motion. ESDU

N92-34161# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

INTRODUCTION TO FLUTTER OF WINGED AIRCRAFT, VOLUME 2

1992 501 p Lecture series held in Rhode-Saint-Genese, Belgium, 9-13 Dec. 1991

(ISSN 0377-8312)

(VKI-LS-1992-01-VOL-2; ETN-92-92163) Avail: CASI HC A22/MF A04

Papers on the following topics are presented: elementary flutter analysis; flight flutter testing; the design, manufacture, and ground testing of flutter models; aeroelasticity of bluff bodies; unsteady wind tunnel tests; flutter in transonic flight regime; and flutter analyses using high speed computers for large aircraft and aerodynamic procedures. The papers are from the second volume of a two volume set.

ESA

N92-34164# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

FLUTTER MODELS: THEIR DESIGN, MANUFACTURE, AND GROUND TESTING

F. DUPRIEZ /n VKI, Introduction to Flutter of Winged Aircraft, Volume 2 25 p 1992

Avail: CASI HC A03/MF A04

Dynamically similar models (similar to the aircraft in their geometric, elastic, and mass representations) are used for the general investigation of flutter. However, there are similarity defects and rules, and these are discussed. A system for suspending the model in the wind tunnel is described. The flutter model design and construction technologies used are discussed. Static and dynamic tests are considered. ESA

N92-34166# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

UNSTEADY WIND TUNNEL TESTS

P. M. HUTIN /n VKI, Introduction to Flutter of Winged Aircraft, Volume 2 38 p 1992

Avail: CASI HC A03/MF A04

Various measurements concerning unsteady aerodynamics are discussed. The unsteady pressure measurements in a wing, used as points of comparison for the unsteady aerodynamic computation methods on which flutter computations are based, are mentioned and wind tunnel tests of flutter are analyzed. Various measurements, their use, and the safety systems are discussed to give an overview of what can be done in this area. ESA

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

A92-12347

AUTOMATION OF THE MEASUREMENT PROCESS IN THE N2 WIND TUNNEL WITH THE SPITA N-3 SYSTEM
[AUTOMATYZACJA PROCESU POMIAROWEGO W TUNELU N-2 Z WYKORZYSTANIEM UKŁADU SPITA N-3]

MALGORZATA ORLINSKA (Instytut Lotnictwa, Warsaw, Poland)
 Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 72-86. In Polish. refs

The method of the SPIT A N-3 system application for measurement automation in the N2 wind tunnel is presented. A dedicated measurement-information system was produced. It was used to calibrate the ventilated, transonic measurement chamber of the N2 tunnel. Author

A92-13675

DISTURBANCE OF TRANSONIC WIND TUNNEL FLOW BY A SLOT IN THE TUNNEL WALL

S. RISTIC (Vazduhoplovnotehnicky Institut, Zarkovo, Yugoslavia)
 Experiments in Fluids (ISSN 0723-4864), vol. 11, no. 6, Oct. 1991, p. 403, 404. refs

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Measurements performed with a single slot in the bottom plate of the test section of a transonic wind tunnel are presented. Holographic interferometry is used to visualize the disturbances in the external flow caused by the slot. O.G.

A92-16110

RECENT DEVELOPMENT OF WIND-TUNNEL TEST TECHNIQUES AT ONERA [DEVELOPPEMENTS RECENTS DES TECHNIQUES D'ESSAI EN SOUFFLERIE A L'ONERA]

J. LEYNAERT (ONERA, Chatillon, France) (International Conference on Experimental Fluid Mechanics, Chengdu, People's Republic of China, June 17-21, 1991) ONERA, TP no. 1991-135, 1991, 20 p. In French. refs

(ONERA, TP NO. 1991-135)
 The development of test techniques in ONERA wind tunnels is reviewed, with emphasis on high-subsonic and low-velocity testing. Particular attention is given to large-scale tests, the automation of facilities, the specifications of test setups, reliability problems, and the refinement of correction methods. L.M.

A92-16128

UTILIZATION OF A RESEARCH SIMULATOR FOR THE DEVELOPMENT OF NEW FLIGHT CONTROL CONCEPTS
[UTILISATION D'UN SIMULATEUR DE RECHERCHE POUR LE DEVELOPPEMENT DE NOUVEAUX CONCEPTS DE COMMANDES DE VOL]

PH. GUICHETEAU (ONERA, Chatillon, France) (NATO, AGARD, Meeting on Piloted Simulation Effectiveness, Brussels, Belgium, Oct. 14-17, 1991) ONERA, TP no. 1991-161, 1991, 12 p. In French. Research supported by DRET, Service Technique des Programmes Aeronautiques, and Group for Aeronautical Research and Technology in Europe. refs

(ONERA, TP NO. 1991-161)
 Studies have been performed that demonstrate the effectiveness of testing the behavior of the complete aircraft with the pilot in the loop by using a research flight simulator as soon as the preliminary design of new FCS is initiated for future aircraft. Three conceptual studies related to mission oriented control systems are presented. Testing of two of these concepts on full flight simulators illustrates the complementary roles of research and full flight simulators. R.E.P.

A92-16135

AERODYNAMIC MEASURING TECHNIQUES FOR TRANSONIC AND SUPERSONIC FLOW IN CASCADES AND TURBOMACHINES

R. GAILLARD (ONERA, Chatillon, France) (Von Karman Institute for Fluid Dynamics, Symposium on Aerodynamic Measuring Techniques for Transonic and Supersonic Flow in Cascades and Turbomachines, Rhode-Saint-Genese, Belgium, Sept. 17-19, 1990) ONERA, TP no. 1991-170, 1991, 19 p.

(ONERA, TP NO. 1991-170)
 The probes used for measuring three-dimensional flows in wind tunnels and turbomachine test stands are generally of small dimensions and have to operate in broad velocity, incidence, and pressure domains. The Aerodynamics Department at ONERA has developed a special test bench that reduces the cost and makes it easier to calibrate these probes. The present paper describes the capabilities of this new test bench. Author

A92-16231

MADRID'S DOUBLE AIRPORT [EL DOBLE AEROPUERTO DE MADRID]

LUIS M. SANCHEZ (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 325, 1991, p. 30-39. In Spanish.

Copyright

The development of the airport is described with specific emphasis given to the incorporation of operations at both the commercial facility and at the adjacent military base. Reference is given to the opinion of the press and local communities, but the paper focuses on the projected needs of the facilities as compared to the present operational capacities. Instrument upgrading is proposed to the level required for between 30 and 40 operations/h, and a new runway is presented for use by 1995. The 1995 runway is designed for precision approaches on a 3,700-m strip capable of 60 operations/h. Depending on the future growth of air traffic, an independent runway is tentatively proposed for the year 2000 that would give the airport the capacity for two takeoff runways and one landing runway permitting 75 operations/h. C.C.S.

A92-18100

HEAVY METAL

DOUGLAS BARRIE Flight International (ISSN 0015-3710), vol. 140, Dec. 18, 1991, p. 18, 20, 22, 23.

Copyright

The philosophy and application behind the extensive use of ground rigs for development of the European Fighter Aircraft is explained as providing an incremental development loop. The ground rig permits the exploration and testing of components and their parameters as they become available, within both an integrated and an isolated test environment. Utilizing a complicated ground rig, with the potential to test the flight-control software and control surfaces, allows the software developers to examine the systems' performance in a near-real, safe environment.

R.E.P.

A92-21125

AIRPORT TERMINALS

CHRISTOPHER J. BLOW (Scott, Brownrigg, and Turner, England) Oxford, England and Stoneham, MA, Butterworth-Heinemann, Ltd., 1991, 199 p. refs

Copyright

The review of terminal facilities refers to a number of existing and new terminals around the globe within the context of their significance and the politics of their design. Terminal-design principles are defined in relation to the issues of capacity, airport master planning, and specific functional types of airport terminals. A taxonomy of aircraft-terminal forms is developed which includes basic terminals with either remote aircraft or mobile lounges, linear terminals, single vs. multiple piers, single vs. multiple satellites, multiple linear units, and hybrid forms. Specific criticisms of landside factors, design details, external airside factors, and terminal redevelopment lead to a proposed methodological approach to terminal design. With extensive illustrations of examples of terminal

design this overview represents a comprehensive design guide and critical resource for ground planning in the airport and aerospace industries. C.C.S.

A92-21922

THE FALSTAFF PROGRAM - A STANDARD SPECTRUM FOR SIMULATING THE SERVICE LOADING OF AIRCRAFT WITH PREVAILING MANEUVER LOADS [PROGRAM FALSTAFF - STANDARDNI SPEKTRUM PRO SIMULACI PROVOZNIHO ZATIZENI LETOUNU S PREVÁZUJICIM MANEVROVÝM ZATIZENIM]

JIRI FIDRANSKY Zpravodaj VZLU (ISSN 0044-5355), no. 5, 1991, p. 233-241. In Czech. refs
Copyright

The use of service loading simulation programs for fatigue testing is discussed with particular reference to the FALSTAFF standard spectrum. Service loading data for different fighter aircraft are compared with the loading history of a jet flight simulator. The final program sequence includes data for 200 flights and is repeated continuously. The generation of peak/through sequences in particular flights is described, and a method for reducing the peak/through cycles per flight is presented. This makes it possible to reduce the time required for fatigue tests. V.L.

A92-26360

PRODUCTIVITY AND QUALITY IN THE MODANE AND FAUGA WIND TUNNELS - PROSPECTS FOR THE 90S [PRODUCTIVITE ET QUALITE DANS LES SOUFFLERIES DE MODANE ET DU FAUGA - LES PERSPECTIVES POUR LES ANNEES 90]

GERARD DOREY (ONERA, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 148-149, 1991, p. 84-92) ONERA, TP no. 1991-203, 1991, 10 p. In French. refs
(ONERA, TP NO. 1991-203) Copyright

This paper presents the current state-of-the-art of the principal ONERA test facilities at the centers of Modane-Avrieux and Le Fauga-Mauzac, and discusses the present objectives to enhance quality and productivity. The aerodynamic facilities cover the entire Mach number regime from the low speeds of takeoff and landing to the very high velocities of acceleration and reentry in the earth's atmosphere. Attention is given to a program of modernization and development in synergy with the development of CFD, and in the framework of European cooperation. R.E.P.

A92-26371

TESTS OF MODELS EQUIPPED WITH A TURBOFAN POWERED SIMULATOR IN THE ONERA F1 LOW-SPEED PRESSURIZED WIND TUNNEL [ESSAIS DE MAQUETTES MOTORISEES EQUIPEES DE SIMULATEURS DE REACTEURS DANS LA SOUFFLERIE BASSE VITESSE PRESSURISEE F1, DE L'ONERA]

J. LEYNAERT (ONERA, Chatillon, France) (NATO, AGARD, Symposium on Aerodynamic Engine/Airframe Integration for High Performance Aircraft and Missiles, Fort Worth, TX, Oct. 7-11, 1991) ONERA, TP no. 1991-219, 1991, 6 p. In French. refs
(ONERA, TP NO. 1991-219)

The particular conditions of tests of models equipped with a turbofan powered simulator (TPS) at high Reynolds numbers in a pressurized wind tunnel are presented. The high-pressure air supply system of the wind tunnel, the equipment of the balance with the high-pressure traversing flow and its calibration, and the thrust calibration method of the TPS and its verification in the wind tunnel are described. R.E.P.

A92-39514

AIRPORT TECHNOLOGY INTERNATIONAL 1992

MAURICE G. HUDSON, ED. London, Sterling Publications, Ltd., 1992, 242 p. No individual items are abstracted in this volume. Copyright

The present yearbook on airport-related technical, commercial, and regulatory developments for 1992 discusses international policies and legislation, airport-policy management in the U.S. and Europe, prospects for Eastern European airport development, the efficient design and operation of intra-transport transit systems,

CAD applications in airport civil engineering, the German airport-capacity crisis, and novel methods for passenger handling. Also discussed are airport security operations, maintenance techniques, airfield fire and deicing operations, ATC and navigation, and airport personnel training. O.C.

A92-45314

RECENT DEVELOPMENTS AT THE SHOEBOURNE STOVL TEST FACILITY

L. H. K. REED (Rolls-Royce, PLC, Bristol, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.2.1-III.2.8. Research supported by Rolls-Royce, PLC and Ministry of Defence of England. Previously announced in STAR as N92-22096.

Copyright

The last two years have seen a number of test programs performed that are directly targeted at the technology acquisition need for the next generation of STOVL (Short Take Off Vertical Landing) fighter aircraft. The facilities used comprise a dynamic test gantry with airframe and two augmented powerplants allowing operation in ground effect to be simulated at full scale over a wide range of jet energies and configurations. The areas of concern in the ground environment of a STOVL vehicle are described, together with how the current test programs are acquiring the knowledge to give confidence that the design solution will be satisfactory. Author

A92-45323

GROUND SURFACE EROSION - BRITISH AEROSPACE TEST FACILITY AND EXPERIMENTAL STUDIES

ALISON J. WAKE, C. J. HILL (British Aerospace /Military Aircraft/, Ltd., Preston, England), and R. G. A. ANGEL (British Aerospace /Military Aircraft/, Ltd., Kingston-upon-Thames, England) IN: International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings. London, Royal Aeronautical Society, 1990, p. III.11.1-III.11.11. refs

Copyright

ASTOVL combat aircraft studies of the erosion of the landing surface during vertical lift operation are discussed. Attention is given to a facility commission at British Aerospace, with emphasis on the laboratory, vented via roof and wall louvers; the ground erosion rig, consisting of a combustion chamber, support tower and linear motor track; and the valve house, including the air and fuel systems. The facility is capable of producing jet pressure ratios from 1.1 to 10 with both quiescent, and from 450 to 1500 K, exhaust temperatures. Current studies are aimed at a precise definition of operational limitations of surfaces presently used by Harrier including the implications of rolling/creeping landing. Results of investigations of the implications of test techniques and assumptions used are presented. C.A.B.

A92-48600

NEW HYPersonic TEST METHODS DEVELOPED AT ONERA - THE R5 AND F4 WIND TUNNELS [NOUVEAUX MOYENS D'ESSAIS HYPersonIQUES DEVELOPPES A L'ONERA - LES SOUFFLERIES R5 ET F4]

B. CHANETZ, M.-C. COET, D. NICOUT, T. POT, P. BROUSSAUD, G. FRANCOIS, A. MASSON (ONERA, Chatillon, France), and D. VENNEMANN (ESA/CNES Joint Group, Toulouse, France) (NATO, AGARD, Symposium on Theoretical and Experimental Methods in Hypersonic Flows, Turin, Italy, May 4-8, 1992) ONERA, TP no. 1992-39, 1992, 13 p. In French. refs
(ONERA, TP NO. 1992-39)

The R5 wind tunnel allows the simulation of hypersonic flows at low Reynolds numbers, corresponding to intake conditions encountered at altitudes of about 60 km. The F4 wind tunnel is projected to study the effects of actual gas and especially effects associated with chemical kinetics during atmospheric reentry. Attention is given to the performance, installation details and description of the introduction of wind tunnel testing. R.E.P.

A92-54322

CONCEPTION OF A UHB ENGINE SIMULATOR FOR THE ESSENTIAL CHARACTERISTICS OF A TRUE-SCALE ENGINE

H. T. BOLMS and W. BRAEUNLING (DLR, Goettingen, Germany)
IN: ICASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 190-195. refs
Copyright

Turbine powered simulators (TPSS) usually are not able to simulate the whole spectrum of characteristic features of an original engine correctly and simultaneously. The difficulties in scaling down an engine are the reasons for these deficiencies. The order of magnitude of the errors resulting from these problems is shown for a turbine powered simulator set up conventionally. A revised simulator concept that avoids most of the significant deficiencies of conventional simulators is presented. A correct simulation, which permits the full transmission of simulation results to the real engine, requires the correct simulation of the secondary cycle, the primary nozzle flow, and the inlet flow. Contrary to a conventional TPS, the new concept, besides the correct simulation of the specific thrust, also allows the correct simulation of the thrust partition between the secondary and the primary cycle. I.E.

A92-54323

RECENT DEVELOPMENTS IN DATA ACQUISITION AND CONTROL SYSTEMS AT THE AIRCRAFT RESEARCH ASSOCIATION LIMITED

DAVID G. COULTON (Aircraft Research Association, Ltd., Bedford, United Kingdom) IN: ICASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 196-205. refs
Copyright

The data acquisition systems (DASs) described are all based on the one connected to the 2.74-m x 2.44-m transonic wind tunnel which is the main testing facility at Aircraft Research Association Limited. The systems are based on Radstone single-board computers utilizing Motorola 68020 processors operating on the VME bus. Each DAS interfaces with a PRIME computer that is dedicated to point-by-point computation and presentation of fully corrected wind tunnel results. The additional systems described include an intelligent controller for electronically scanned pressure modules, the transonic wind tunnel automated test system, and the captive trajectory rig. The main features of the various data acquisition systems are highlighted, and the design concepts of several other applications of single-board computers are described. I.E.

A92-54336

APPLICATION OF A WALL PRESSURE METHOD IN A WIND TUNNEL TEST SECTION WITH ADJUSTABLE LONGITUDINAL SLOTS

H. HOLST and A. HEDDERGOTT (DLR, Goettingen, Germany)
IN: ICASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 304-313. refs
Copyright

Green's theorem has been applied to the problem of wind tunnel wall interference. A wall pressure method for test sections of rectangular cross sections has been completed, which can be used for the computation of wall interferences, wall adaptation and, in case of adaptive test sections, for residual wall interferences. For these cases, a single computational step is sufficient. Measurements in the transonic wind tunnel TWG of DLR Goettingen with adjustable longitudinal slots on the top and bottom walls show that for this special application the determination of residual wall interference is also reliable. Test data, e.g., force coefficients, can be corrected to be approximately interference-free, using the residual interference velocities. After correction, the discrepancies between test data from different slot widths were substantially reduced. I.E.

A92-56773#

AN OVERVIEW OF THE PLANNED AEROSPACE TEST FACILITIES AT CAPUA, ITALY

ANGELO GARRONE (Centro Italiano Ricerche Aerospaziali, Capua, Italy) and LEON H. ZACHO (Fluidyne Engineering Corp., Minneapolis, MN) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992, 6 p. refs
(AIAA PAPER 92-3944) Copyright

The paper describes the major wind tunnel facilities that will be built at the Centro Italiano Ricerche Aerospaziali (CIRA) located at Capua, Italy. These facilities include a low speed wind tunnel (LSWT), a high Reynolds number transonic wind tunnel (HRTT), and a plasma wind tunnel (PWT), providing state-of-the-art test capability in the subsonic, transonic, and hypersonic regimes. The HRTT design incorporates a unique drive concept to minimize the installed power requirement; a single stage fan will be used for operation at low speeds, and a compressed air injector will be used at transonic speeds. The LSWT and HRTT will support the research and development needs of the Italian and other European aerospace industries. The PWT will support the development of the European Space Agency's Hermes space plane. Author

A92-56784#

INVESTIGATION OF A PLATE-RAMP-CONFIGURATION BY MEANS OF LASER DOPPLER ANEMOMETRY AT MACH 2.95

D. REISINGER, W. HEISER, D. OLEJAK, and S. WAGNER (Muenchen, Universitaet der Bundeswehr, Munich, Germany) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992, 12 p. refs
(Contract DFG-SFB-255)
(AIAA PAPER 92-3956) Copyright

A 6-Watt argon-ion laser Doppler anemometer implemented in a ground testing facility for 2D investigations in supersonic flows is described, and first results are presented. The flow field investigated was a compression corner flow over a 5-deg ramp at a free-stream Mach number of 2.95. It is shown that accurate determination of the position of the probe volume is essential when taking LDA measurements close to the wall. An interferometric approach is presented whereby the position of the probe volume can be determined. Velocity and turbulent kinetic energy profiles are compared with calculations using an extended Wilcox-k-w-model. V.L.

A92-56798#

THE SR3 LOW DENSITY WIND TUNNEL - FACILITY CAPABILITIES AND RESEARCH DEVELOPMENT

J. ALLEGRE (SESSIA; CNRS, Laboratoire d'Aerothermique, Meudon, France) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992, 7 p. refs
(AIAA PAPER 92-3972) Copyright

The general layout, operation, and capabilities of the SR3 low-density wind tunnel are described. Through the use of different nozzles, the SR3 facility is capable of generating subsonic, supersonic, and hypersonic flows up to Mach 22, covering a wide range of Reynolds numbers. The discussion covers the operation of the principal components of the wind tunnel, including an electron gun, external and sting aerodynamic balances, pressure transducers, heat transfer gages, and an infrared thermography camera. Recently conducted experimental studies have included work on delta wing configurations and characterization of the flight performance of the Hermes space plane. V.L.

N92-11020# Association Aeronautique et Astronautique de France, Paris.

APPLICATION OF INFRARED THERMOGRAPHY TO THERMAL FLUX MEASUREMENT IN WIND TUNNELS [APPLICATION DE LA THERMOGRAPHIE INFRAROUGE A LA MESURE DES FLUX THERMIQUES EN SOUFFLERIE]

D. BALAGEAS (Centre d'Etudes et de Recherches, Toulouse (France)), D. BOSCHER (Centre d'Etudes et de Recherches, Toulouse (France)), P. DELPECH, A. DEOM, J. FOURNIER, G. GARDETTE, C. LEMPEREUR, P. BERTHOUMIEUX, and J. M. MATHE (Centre d'Etudes et de Recherches, Toulouse, France)

1989 21 p In FRENCH Presented at the 26th Colloque d'Aerodynamique Appliquee, Toulouse, France, 23-25 Oct. 1990 Previously announced in IAA as A90-21051 Sponsored by Direction des Recherches, Etudes et Techniques; Service Technique des Programmes Aeronautiques; CEA; and Societe Matra

(ISSN 0243-0177)

(AAAF-NT-89-12; ISBN-2-7170-0945-0; ETN-91-99953) Avail: CASI HC A03/MF A01; CEDOCAR, Section des Diffusions, 26 Blvd Victor, 75996 Paris Armees, France, HC 15 francs

Different thermographic measuring methods are presented: passive thermography, in which the model is heated only by convection; stimulated thermography, in which a short radiative flux is superimposed. Practical examples of wind tunnel measurements are presented. A variety of technical problems to be resolved are addressed, related in particular to the three dimensionality of models, the control of their emissivity, to the presence of porthole windows, and to the quite limited spatial resolution of thermographic images obtained with current industrial imagers. ESA

N92-12005# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Windtunnels Central Div.

PROCEDURE FOR DETERMINATION OF THREE-DIMENSIONAL WIND TUNNEL WALL INTERFERENCES AND WALL ADAPTATION IN COMPRESSIBLE SUBSONIC FLOW USING MEASURED WALL PRESSURES

HARTMUT HOLST 1 Mar. 1991 171 p Original language document was announced as N91-23088

(ISSN 0171-1342)

(DLR-FB-91-09; DLR-FB-90-46; ETN-91-90041) Avail: CASI HC A08/MF A02; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 60 DM

A method for the determination of three dimensional wind tunnel wall interferences and wall adaptation, valid up to high subsonic Mach numbers, is presented. Green's theorem is applied to the problem of wall interferences in wind tunnels. Data required for the calculation are the velocity components at the boundaries of the test section; the computation of the wall adaptation is performed in a single step. Measurements in an adaptive test section prove that the method can be used for the determination of wall interferences, wall adaptation, and residual interferences. Optimization of slot widths in test sections with longitudinally slotted walls as well as the computation of residual interferences can also be performed using this method. This is demonstrated by computations. The limitations of the method are discussed. ESA

N92-12006# Institut de Mecanique des Fluides de Lille (France).

STUDY OF INTERACTIONS ON ANEMOCLINOMETRIC SENSORS [ETUDE D'INTERACTIONS SUR SONDES ANEMOCLINOMETRIQUES]

M. PRUVOST and P. BAILLEUX 24 Sep. 1990 44 p In FRENCH

(Contract DRET-89-003-03)

(REPT-90/30; ETN-91-90110) Avail: CASI HC A03/MF A01

The use of anemoclinometric sensors as measuring tools in wind tunnels is studied. The calibration of such sensors can be thrown off due to close proximity to the walls of the wind tunnel. The inaccuracies induced by these sensor/wall panel interactions can be due to local magnetic fields. Obstructions in the wind tunnel may directly affect the antenna and alter the aerodynamic behavior of the sensor. Pressure gradients within the flow may also affect the sensors. The distortions in the aerodynamic field of wind tunnels which lead to such sensor inaccuracies are studied. ESA

N92-13076# General Accounting Office, Washington, DC. **AEROSPACE TECHNOLOGY: TECHNICAL DATA AND INFORMATION ON FOREIGN TEST FACILITIES**

Jun. 1990 584 p

(GAO/NSIAD-90-71FS; B-235387) PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies \$2.00

This report provides data and information collected by the General Accounting Office (GAO) on foreign government and industry investment in aerospace vehicle research and technological development efforts. The focus is on those critical or enabling technologies that could allow foreign countries to develop and build future aerospace vehicles. The report also identifies indicators for measuring foreign countries' current state of aerospace vehicle technological development and progress. The review includes France, West Germany, the United Kingdom, and Japan, since each of these countries are developing technologies for various concepts of operational aerospace vehicles to secure independent access to space and reduce the costs of launching payloads into orbit. Also included are facilities, such as wind tunnels, in The Netherlands, Belgium, Italy, and Australia because their test facilities are being used to conduct research and development of air-breathing aerospace vehicles by other countries and the European Space Agency (ESA). Information was collected on test facilities, their capabilities, and the number of people working on aerospace vehicle research and development in the countries that were included in the review. Facilities include (1) wind tunnels and shock tunnels, (2) air-breathing propulsion test cells (engine test facilities for ramjets and scramjets), (3) aerothermal test facilities, (4) aeroballistic and impact ranges, (5) advanced materials research, development, production, and fabrication laboratories, and (6) aerodynamic computation facilities (supercomputers). Cost information collected on test facilities included construction, replacement, annual operating, and, where available, user costs. J.P.S.

N92-14027# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

A TAXI AND RAMP MANAGEMENT AND CONTROL SYSTEM (TARMAC)

U. VOELCKERS In Communications Gillies, Inc., Electronic Systems in Transportation p 94-98 Sep. 1989

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The development of safe and efficient low visibility ground operations has become very important with the increasing use of sophisticated systems such as Cat IIIa/b which allow all-weather approaches and landings. The high traffic rate at major airports has made improved ground operations important even for good weather. This paper outlines a general concept for a new airport ground movement control system (GMCS) currently under development at the German Aerospace Research Establishment (DLR). The GMCS system should provide complete information on the position, identity, and progress of aircraft and other vehicles operating in the movement area as well as supplying information on the positions of stationary hazards. Digital data should be used in approach, departure, and flow control. Communications with aircraft should be mainly via digital data and voice communications should be minimized. The system should provide the pilot with detailed guidance information. It should include automatic conflict avoidance and resolution. The system should be of modular design so that it can adapt to any airport structure and any traffic volume. It should have all-weather functionality, comply with International Civil Aviation Organization (ICAO) regulatory documents, and function as an integral part of air traffic control systems. CISTI

N92-14999# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Aerothermodynamics Section.

SIMOUN AND SCIROCCO WIND TUNNEL NOZZLE VISCOUS FLOW STUDY

D. GIORDANO, L. MARRAFFA, and G. RUSSO (Centro Italiano Ricerche Aerospaziali, Naples.) In its Aerothermodynamics for Space Vehicles p 197-207 Jul. 1991

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The results obtained during a first study phase about the flow

09 RESEARCH AND SUPPORT FACILITIES (AIR)

fields in the SIMOUN and Scirocco wind tunnel nozzles are presented. The geometrical configurations analyzed here are conical with circular section of Scirocco and contoured with semicircular section for SIMOUN. Air is the working fluid and it was assumed to behave as an ideal gas in chemical and thermal equilibrium. Two dimensional and three dimensional results were produced by SPEAR/3D, a computer program which solves the parabolized Navier-Stokes equations. Isoline contours and transversal profiles of flow field parameters are shown to give an understanding of the flow patterns which settle on the nozzles under different operating conditions. The flow field characteristics and the limitations deriving from the assumptions on which the calculations were based are discussed; accordingly, future developments of the study are envisaged. ESA

N92-15001# Deutsche Airbus G.m.b.H., Bremen (Germany).

SHORT TIME FORCE MEASUREMENT SYSTEM

JOSEF MERTENS and KLAUS KOENIG *In* ESA, Aerothermodynamics for Space Vehicles p 223-227 Jul. 1991
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The development of the SFS (Short time Force and moment measurement System) is considered. It enables measurement of aerodynamic forces and moments at testing times of less than 10 ms. This is required for measurements in high enthalpy shock tunnels to simulate reentry flight. Measurement is done using distributed accelerometers. The one year development program will comprise: development of software for modal analysis, correction and evaluation, development of a suited suspension system, development of calibration methods, test loading of a generic model with a precise load on a shock tube's endwall. ESA

N92-15002# Naples Univ. (Italy).

INFRARED MEASUREMENTS OF AERODYNAMIC HEATING IN HYPERSONIC WIND TUNNEL

L. DELUCA (Naples Univ. (Italy).), G. CARDONE (Naples Univ. (Italy).), G. M. CARLOMAGNO (Naples Univ. (Italy).), T. ALZIARYDEROQUEFORT (Centre d'Essais Aeronautique Toulouse (France).), and D. AYMERDELACHEVALERIE (Centre d'Essais Aeronautique Toulouse, Poitiers, France) *In* ESA, Aerothermodynamics for Space Vehicles p 229-234 Jul. 1991
Sponsored by Centro Italiano Ricerche Aerospaziali and Avions Marcel Dassault-Breguet Aviation
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Significant results referring to flow visualizations and heat transfer measurements performed by means of an infrared scanning radiometer in a blowdown hypersonic wind tunnel on delta wing and ellipsoids models are discussed. Tests are carried out within the European Community space program Hermes to develop the first European space shuttle. Comparisons of infrared data with oil film flow visualizations, thermocouple measurements and numerical results are presented. ESA

N92-15003# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Div. de Thermophysique.

HEAT TRANSFER MEASUREMENTS IN ONERA SUPERSONIC AND HYPERSONIC WIND TUNNELS USING PASSIVE AND ACTIVE INFRARED THERMOGRAPHY

D. L. BALAGEAS, D. BOSCHER, A. A. DEOM, and G. GARDETTE *In* ESA, Aerothermodynamics for Space Vehicles p 235-240 Jul. 1991 Previously announced in IAA as A91-45632 Sponsored in part by Direction des Recherches, Etudes et Techniques; CEA; and Cryospace Co.
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Over the past few years, a major intellectual and technical investment has been made at ONERA to use data acquisition systems and data reduction procedures using an infrared camera as a detector under routine wind tunnel conditions. This allows a really quantitative mapping of heat transfer rate distributions in models in supersonic and hypersonic flows. Sufficient experience

has been required, and an overview of the following is given: the systems and data reduction procedures developed for both passive and active methods; typical results obtained various configurations such as supersonic axisymmetrical flow around an ogival body (passive and active thermography), heat flux modulation in the reattachment zone of a flap in hypersonic regime, transitional heating in very slightly blunted sphericoconical bodies in hypersonic flows, and materials testing in high enthalpy hypersonic flow (passive thermography). ESA

N92-15009# Stuttgart Univ. (Germany). Inst. fuer Raumfahrtssysteme.

THE IRS PLASMA WIND TUNNELS FOR THE INVESTIGATION OF THERMAL PROTECTION MATERIALS FOR REENTRY VEHICLES

M. AUWETER-KURTZ, H. HABIGER, S. LAURE, E. W. MESSERSCHMID, W. ROECK, and N. TUBANOS *In* ESA, Aerothermodynamics for Space Vehicles p 283-293 Jul. 1991
Copyright Avail: CASI HC A03/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The plasma wind tunnels PWK1 and PWK2 were designed to test thermal protection materials for space vehicles. They are suitable for the qualification of ablative materials as well as for heat resistant ceramics such as C-C or C-SiC. In either case, a steady state heating environment including transient conditions at the surface of space transportation systems during the early reentry phase are simulated as close to reality as possible. Such plasma wind tunnels represent the only possible way to investigate candidate materials with respect to their surface chemistry associated with erosion or ablation behavior. In these facilities, the emphasis is on reproducing the specific enthalpy of the flow, the wall temperature and heat flux respectively as well as the chemical composition with respect to the main and most reactive components on the surface of the tested specimens rather than aerodynamic similarities. The plasma wind tunnels are characterized in terms of specific enthalpy, pressure, heat flux, and mass flow. The simulation requirements are discussed with respect to the erosion mechanisms of modern heat shield materials. It is shown that the environment of the nose cap and at the leading edge of Hermes during the first phase of reentry, including the points of maximum temperature, can be simulated as well as the conditions during the reentry of the space probe Rosetta. ESA

N92-15012# Naples Univ. (Italy).

ASPECTS OF NON-EQUILIBRIUM IN ARC-HEATED WIND-TUNNEL SIMULATION

R. MONTI (Naples Univ. (Italy).), G. RUSSO (Italian Aerospace Research Center, Naples.), and G. PAGLIOCCA (Techno System Developments, Naples, Italy) *In* ESA, Aerothermodynamics for Space Vehicles p 307-314 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Problems of the air flow in continuous arc heated wind tunnels and in the different parameters that characterize the flow field in the test section are addressed. Pressure, velocity, and dimension are not sufficient to duplicate the flight conditions due to nonequilibrium effects; this is especially true for heat transfer problems in reentry conditions. Wind tunnel experimental results cannot duplicate the results of real flight conditions, because of the different contributions of the sensible, chemical, and kinetic energies to the total enthalpy of the air flow. In particular, air flow evolution behind shock waves over blunt bodies was considered and the main parameters are evaluated at different nonequilibrium conditions in the test section. Numerical analysis and considerations are related to the present and potential capabilities of the arc heated continuous plasma wind tunnel (Scirocco). ESA

N92-18341# Manchester Univ. (England). Aeronautical Engineering Group.

THE INSTALLATION OF THE AVRO 9 BY 7 FOOT LOW-SPEED WIND TUNNEL AT THE UNIVERSITY OF MANCHESTER (ENGLAND)

D. I. A. POLL 1990 16 p
(Contract GRF/58646)
(AERO-REPT-9005; ETN-92-90922) Avail: CASI HC A03/MF A01

The acquisition of the low speed tunnel, a university based facility having potential for fundamental high Reynolds number research in fluid dynamics, is described. The basic layout and leading dimensions of the tunnel are shown. The tunnel is of the closed return type which means that the power consumption for a given test speed is low. The principal design features and quoted performance figures are given. The move to the Goldstein Aeronautical Engineering Laboratory (north west of Manchester) is described. ESA

N92-18416# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

MODEL INCIDENCE MEASUREMENT USING SAAB ELOPTOPOS SYSTEM

P. H. FUYKSCHOT 23 May 1989 8 p Presented at the 13th International Congress on Instrumentation in Aerospace Simulation Facilities, Goetigen, Fed. Republic of Germany, 18-21 Sep. 1989 (NLR-TP-89182-U; ETN-92-90959; AD-B158641L) Avail: CASI HC A02/MF A01

For measuring the angle of attack of models in a transonic windtunnel, a SAAB ELOPTOPOS system was acquired. The system consists of two infrared Light Emitting Diodes (LEDs) mounted fore and aft in the fuselage of the model, two linear array Charged Coupled Device (CCD) cameras, and special processors. The cameras are mounted to the sidewall of the windtunnel and have a viewing angle of 60 deg in the vertical direction. Thanks to a special optimizing algorithm, the camera resolution is enhanced to 0.001 deg. At a viewing distance of one meter, the resulting resolution in angle of attack of the model is typically 0.0026 deg. The system is individually calibrated for each mode under wind off conditions, using an extremely accurate gravity sensing inclinometer as a reference. This procedure ensures the required accuracy of 0.01 deg in angle of attack under wind on conditions. ESA

N92-20385# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique.

PHOTOLUMINESCENCE THERMOGRAPHY: PINPOINT STUDY OF A LINEAR LUMINOPHORE; LABORATORY EVALUATION; AND PRELIMINARY GUST WIND TUNNEL TESTS Final Summary Report [THERMOGRAPHIE PAR

PHOTOLUMINESCENCE: ETUDE EN MESURE PONCTUELLE D'UN LUMINOPHORE LINEAIRE; EVALUATION EN LABORATOIRE ET PREMIERS ESSAIS EN SOUFFLERIE A RAFALE. RAPPORT DE SYNTHESE FINAL]

P. BAUMANN Jan. 1991 67 p In FRENCH
(Contract DRET-89-34-001)

(ONERA-RSF-128/1865-AY-726A; ETN-92-90873) Avail: CASI HC A04/MF A01

A feasibility study for a thermographic process using photoluminescence in a hypersonic wind tunnel, is described. Evaluation of the thermometric potential of linear luminophores and rare earth composites is carried out outside of a wind tunnel. Initial tests in a gusting hypersonic wind tunnel are described. The tests indicate global feasibility of the technique despite perturbations due to environmental factors. The thermometric parameter is shown to be independent of the main factors influencing photoluminescence in thermography. ESA

N92-22096# Rolls-Royce Ltd., Bristol (England). Military Demonstrators.

RECENT DEVELOPMENTS AT THE SHOEBOURNESS (ENGLAND) STOV L TEST FACILITY

L. H. K. REED 1 Sep. 1990 10 p
(PNR-90806; ETN-92-90776) Copyright Avail: CASI HC A02/MF A01

The last two years have seen a number of test programs performed that are directly targeted at the technology acquisition need for the next generation of STOV L (Short Take Off Vertical

Landing) fighter aircraft. The facilities used comprise a dynamic test gantry with airframe and two augmented powerplants allowing operation in ground effect to be simulated at full scale over a wide range of jet energies and configurations. The areas of concern in the ground environment of a STOV L vehicle are described, together with how the current test programs are acquiring the knowledge to give confidence that the design solution will be satisfactory in service operation. ESA

N92-27804*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

WIND TUNNEL MAGNETIC SUSPENSION SYSTEMS AT THE UNIVERSITY OF SOUTHAMPTON, ENGLAND

MICHAEL J. GOODYER In NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 775-788 May 1992

Avail: CASI HC A03/MF A04

The magnetic suspension system at Southampton University was used in two roles: as a device for producing useful aerodynamic data, and as a vehicle to develop and demonstrate new technology for application to a projected larger facility. Examples of both follow, beginning with an outline of the quest to develop methods for reaching high angles of attack because of current interest in researching the associated aerodynamics. Author

N92-28523# Federal Ministry for Defence, Bonn (Germany). Armaments Technology Directorate.

OPPORTUNITIES FOR FLIGHT SIMULATION TO IMPROVE OPERATIONAL EFFECTIVENESS

J. HEYDEN In AGARD, Piloted Simulation Effectiveness 15 p Feb. 1992

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The keynote address gives an overview over the opportunities of piloted simulation for the development of aircraft and for the training of aircrews to operate the aircraft. Based on the military flight mission requirements some critical issues of peacetime military operations in Europe are discussed and the resulting opportunities for application of flight simulation in development and training are presented. The address concludes on recommendations for piloted simulation. Author

N92-28526# Aerospatiale, Toulouse (France).

FLIGHT SIMULATION AND DIGITAL FLIGHT CONTROLS

D. CHATRENET In AGARD, Piloted Simulation Effectiveness 4 p Feb. 1992

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The A-320 is the first civil airliner to make extensive use of digital flight controls. Despite previous experience with this technology, developing this system quickly has proven a challenge. Flight simulation with a high degree of fidelity has played a key role in flight control development. Simulation has also complemented the flight testing of the A-320-200. Digital flight control has moved the critical areas from aerodynamic model accuracy to flight control system representation exactness. Simulator acceptance procedures had also to be adapted to address the case of closed loop controlled aircraft correctly. Author

N92-28532# National Aerospace Lab., Amsterdam (Netherlands).

AIRCRAFT SIMULATION AND PILOT PROFICIENCY: FROM SURROGATE FLYING TOWARDS EFFECTIVE TRAINING

P. G. A. M. JORNA (National Aerospace Lab., Amsterdam (Netherlands).), E. R. A. VANKLEEF (Royal Netherlands Air Force, The Hague.), and W. P. DEBOER In AGARD, Piloted Simulation Effectiveness 8 p Feb. 1992

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Simulators are currently built as simple system 'look-a-likes' and a structured or experimentally validated approach to their use and implementation as part of a comprehensive training system is lacking. This is one reason why their use in training was not always as successful as expected. This paper reviews some experiences with the application of simulators in military flight

09 RESEARCH AND SUPPORT FACILITIES (AIR)

training and it reports research strategies like the development of objective performance measures in support of validation trials and future simulator development. It is proposed to prototype simulator concepts before implementing them and relevant research initiatives in this area are reviewed. Author

N92-28536# Alenia, Torino (Italy). Flight Simulation Center.
AM-X FLIGHT SIMULATOR FROM ENGINEERING TOOL TO TRAINING DEVICE

A. ARMANDO, P. CASTOLDI, and F. FASSI /in AGARD, Piloted Simulation Effectiveness 12 p Feb. 1992
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Effectiveness of Flight Simulation with pilot-in-the-loop can be intended rather differently depending on the context in which the simulation activities are carried out, namely in the two traditional areas of Research & Development (R&D) and Training. In the latter case, effectiveness can be considered the amount of training a simulator is able to transfer per time unit, while in the case of R&D simulation its effectiveness is related to the amount of confidence engineers can gain in the prediction of an airborne system behavior before releasing it to the real flight. Pursuing the maximization of effectiveness in these two different contexts leads to different approaches in applying simulation methodologies. This paper will show to what extent a simulation facility created and continuously improved to support the development of a new attack aircraft, the AM-X, was finally capable of training operational pilots during the conversion to that aircraft. Author

N92-28539# CAE Electronics Ltd., Saint Laurent (Quebec).
THE EVALUATION OF SIMULATOR EFFECTIVENESS FOR THE TRAINING OF HIGH SPEED, LOW LEVEL, TACTICAL FLIGHT OPERATIONS

ANDREW MORRIS (CAE Electronics Ltd., Montreal (Quebec).) and PAUL E. VANHEMEL (CAE-Link Corp., Alexandria, VA.) /in AGARD, Piloted Simulation Effectiveness 11 p Feb. 1992
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The German Government has initiated a three phase program to evaluate the use of an improved simulator for the Tornado aircraft. In the first phase of this program computer aided engineering (CAE) has built a prototype simulator, referred to as the Evaluation Unit (EU). The improvements in the EU consist of visual system upgrades to provide a CAE Fiber-Optic Helmet Mounted Display (FOHMD) for the pilot and weapon system officer (WSO), with imagery from an Evans & Sutherland ESIG-1000 image generator, as well as a six-degree of freedom (DOF) motion system. The EU was installed at CAE Electronics GmbH in Stolberg, Germany. Military and industrial representatives are conducting an evaluation of the upgraded simulator to assess its capability to provide high speed, low level, tactical flight operations training capability. A factorial analysis of variance (ANOVA) design is being used to objectively assess recorded performance data and subjective impressions data collected during simulator flights by military crews from the German Air Force and Navy. Author

N92-28541# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany).

DEVELOPMENT AND EVALUATION OF AN ATTACK AND MANEUVERING SYSTEM WITH COMBAT DEVELOPMENT SIMULATORS AS MAIN DEVELOPMENT TOOL

HERBERT EIBL, HANS-GUENTER OFFENBECK, and HANS W. PONGRATZ /in AGARD, Piloted Simulation Effectiveness 17 p Feb. 1992

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As a result of conceptual design work on future fighter aircraft and of future air/air weapons it was concluded that in future air/air combat, especially in the beyond visual range (BVR) scenario, a pilot has to be supported by means of intelligent onboard processing equipment in order to fulfill his most demanding tasks by fully exploiting the weapon system capabilities. An integrated fire and tactical flight director control system was developed for the entire air combat arena by DASA MBB's Military Aircraft Division in its manned simulator facility. A description of the developed system and the used simulator facility is given. As a first step to

verify this development, the Attack and Maneuvering System (AMS) for the BVR-air combat was successfully evaluated by the German Air Force in a large scale manned realtime simulation study. It was demonstrated that such a system can significantly improve the combat effectiveness of a modern fighter aircraft in the BVR-scenario by a factor of up to 6. Author

N92-28543# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

USE OF A RESEARCH SIMULATOR FOR THE DEVELOPMENT OF NEW CONCEPTS OF FLIGHT CONTROL [UTILISATION D'UN SIMULATEUR DE RECHERCHE POUR LE DEVELOPPEMENT DE NOUVEAUX CONCEPTS DE COMMANDES DE VOL]

PH. GUICHETEAU /in AGARD, Piloted Simulation Effectiveness 11 p Feb. 1992 In FRENCH; ENGLISH summary
Copyright Avail: CASI HC A03/MF A03

Several studies performed at ONERA have shown the usefulness of testing the behavior of the whole aircraft with the pilot in the loop by using a research flight simulator as soon as the preliminary design of new FCE for future aircraft is undertaken. The communication presents three conceptual studies related to mission oriented control systems which were performed at ONERA's research flight facility. The description of the conceptual phase of each of these studies and, for two of them, of their further validation on full flight simulators allows a conclusion about the complementary roles of research and full flight simulators. Author

N92-28544# Dassault-Breguet Aviation, Saint Cloud (France).

THE ROLE OF SIMULATION FOR THE STUDY OF APIS (PILOTING SUPPORT BY SYNTHETIC IMAGERY) (LE ROLE DE LA SIMULATION POUR L'ETUDE APIS (AIDE AU PILOTAGE PAR IMAGERIE SYNTHETIQUE))

PIERRE LARROQUE, PIERRE PAGNIEZ, and ROLAND MIGINIAC /in AGARD, Piloted Simulation Effectiveness 12 p Feb. 1992 In FRENCH
Copyright Avail: CASI HC A03/MF A03

This report presents different methods of simulation used at Dassault Aviation for the APIS (pilot support by synthetic imagery) study. The aim of this study was to define man-machine concepts for synthetic imagery derived from onboard information and updated in flight. The imagery system provides the pilot with a comprehension and decision tool that can be used for any flight conditions (low altitude, poor visibility...) and tactical conditions. This document describes: (1) the methods used to produce static images from needs analysis, enabling a preliminary selection of acceptable images; (2) the use of workstations to generate and pilot in real time the solutions retained and to improve the representations; (3) interfacing workstations with a real-time processor and a RAFALE type simulation cabin, permitting manual or automatic execution of a 3-D trajectory in a simple scenario and used after evaluation by 10 pilots; (4) scenarios retained and results obtained as a result of these evaluations; and (5) follow up future spinoffs for the engineering of Dassault fighter aircraft. Transl. by L.B.

N92-28546# Defence Research Agency, Bedford (England). Flight Systems Dept.

INITIAL VALIDATION OF A R/D SIMULATOR WITH LARGE AMPLITUDE MOTION

A. D. WHITE, J. R. HALL, and B. N. TOMLINSON /in AGARD, Piloted Simulation Effectiveness 24 p Feb. 1992
Copyright Avail: CASI HC A03/MF A03

The Advanced Flight Simulator (AFS) Complex at the Defense Research Agency (DRA) at Bedford was enhanced by the addition of a large displacement motion platform and a three channel Computer Generated Image (CGI) outside world visual system. The trial described here was the first in a series of trials aimed at validating the AFS in its present configuration and in particular at demonstrating its ability to address a wide variety of vehicle handling qualities with a high degree of fidelity and user confidence. It included a direct comparison between the ground based AFS

and the Calspan Learjet in-flight simulator. The comparison between the AFS and Learjet involved three pilots flying the same offset approach landing tasks using the same aircraft model in both the AFS and in flight. The lateral handling qualities were varied by adjusting the time constant of a filter in the pilot's roll control loop. Pilot comments, handling quality, and PIO ratings indicate that the AFS reproduces the lateral handling qualities and roll PIO tendencies of the Learjet in-flight simulator with high fidelity. The degradation in handling qualities and increase in PIO tendencies with increasing filter time constant were clearly revealed in both the AFS and Learjet. The importance of good platform motion cueing and task design when evaluating handling qualities was also demonstrated. Author

N92-28547# Deutsche Airbus G.m.b.H., Hamburg (Germany).
USE OF A VIRTUAL COCKPIT FOR THE DEVELOPMENT OF A FUTURE TRANSPORT AIRCRAFT

DIETER KRICKE and WILFRIED QUELLMANN /in AGARD, Piloted Simulation Effectiveness 10 p Feb. 1992 Sponsored in part by BMFT and Council of the European Community
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A development tool called the 'visual cockpit' is discussed. A comparison of civil and military transport aircraft development shows a significant technology gap on the military tactical transport side during the last 30 years. Therefore, it seems very beneficial to consider a 'dual use' of well-proven 'civil technologies' for military applications. Specific military transport missions require aircraft capabilities, some of which are quite new and therefore challenging for transport aircraft (e.g. low level flight profiles in night and poor visibility conditions). The demonstration of the feasibility and an evaluation of technical solutions imply the need for suitable development tools. The Virtual Cockpit is explained in terms of its components (hardware/software), features, and capabilities. A major field of investigation in this context is the aircraft systems' central control and monitoring. Author

N92-28548# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugmechanik.

THE ROLE OF SYSTEMS SIMULATION FOR THE DEVELOPMENT AND QUALIFICATION OF ATTAS

D. HANKE, H.-H. LANGE, and P. SAAGER /in AGARD, Piloted Simulation Effectiveness 11 p Feb. 1992
 Copyright Avail: CASI HC A03/MF A03

The Advanced Technologies Testing Aircraft System (ATTAS) is a flight test vehicle to be used as a flying simulator to demonstrate and validate new methods and technologies. In order to provide broad testing capabilities, ATTAS was heavily modified and equipped with a powerful digital fly-by-wire/light flight control system. Presented here is a technical description of the simulator structure and simulation capabilities. Also addressed is the specific role of system identification techniques for simulator validation. Several examples are given demonstrating system performance. Finally, conclusions concerning the merits of system simulation for the ATTAS development and operation are discussed. Author

N92-28552# British Aerospace Public Ltd. Co., Lancashire (England). Military Aircraft Div.

EFFECTIVE CUEING DURING APPROACH AND TOUCHDOWN: COMPARISON WITH FLIGHT

PETER BECKETT /in AGARD, Piloted Simulation Effectiveness 11 p Feb. 1992
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The importance of the various cues provided by flight simulators is a topic for continual debate. Designers of simulators must wrestle with the issue in order to create a sufficient illusion of flight that allows the pilot to carry out his tasks. Hopefully, he becomes stimulated in a similar manner to the real world and behaves accordingly. For training purposes, we are then reinforcing behavior patterns. In research and development simulation, we become more confident that problems or deficiencies of pilot/aircraft interaction are identified early. Clearly, if the cueing is identical to the real world, we would expect identical behavior from the pilot.

Simulators invariably fall short of this in many ways. What are considered to be essential cueing requirements are often intuitive, sometimes based on experience and sometimes completely open to individual opinion. A good test of cueing effectiveness is a comparison with flight. The cueing issues for landing approach and touchdown of fast jets are discussed here and simulation results are compared with flight. Author

N92-28579# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

THE BASIC RESEARCH SIMULATOR PROGRAMME AND THE INDUSTRIAL AND AEROSPACE COMMUNITY: OPPORTUNITIES FOR COOPERATIVE RESEARCH

S. K. ADVANI Oct. 1991 69 p
 (LR-662; ETN-92-91401) Avail: CASI HC A04/MF A01

The configuration of the basic research simulator and the proposed applications of the facility are outlined. The benefits to industry of the simulator are: the dynamic behavior and control of motion platforms; the performance of vehicle simulations in a ground based environment; and the human factors of vehicle operation. The dynamic behavior of a motion platform can be improved by minimizing the mass of the moving components and by placing the center of gravity in a low vertical location. In practice, metal fiber laminates (hybrid materials) will form the primary structure of the basic research simulator in order to minimize its weight. To lower the center of gravity, the cockpit floor will be attached beneath the primary load bearing frame of the moving platforms and below its gimbals. Further improvements to the dynamic properties will be achieved through the application of multivariable control techniques to drive the six degrees of freedom motion system. A motion system with favorable dynamic properties can serve as an ideal tool for conducting basic research in vehicle simulation and in human factors: motion signal noise and parasitic displacements on the nondriven directions can be virtually cancelled by proper design and control techniques. The provision for flexible cockpit and instrument arrangements supports research into instrument display formats. ESA

N92-28661# National Aerospace Lab., Amsterdam (Netherlands). Aerodynamics Div.

THE WINDTUNNEL AS A TOOL FOR LAMINAR FLOW RESEARCH

A. ELSENAAR 8 May 1990 17 p Presented at 17th ICAS Congress, Stockholm, Sweden, 9-14 Sep. 1990 Previously announced in IAA as A91-24324 Sponsored in part by Netherlands Agency for Aerospace Programs
 (NLR-TP-90145-U; ETN-92-91536) Avail: CASI HC A03/MF A01

Testing laminar airfoils or wings in the wind tunnel entails some specific experimental problems. These problems are discussed using the (limited) experience of laminar flow tests made in a high speed wind tunnel. Special measurement techniques like infrared imaging for transition detection and fast continuous wake rake traverses, are required for detailed drag assessment. Premature transition due to contamination of the airfoil surface appears to be a problem. The transition location in flight is unlikely to be duplicated in the wind tunnel due to flow quality and Reynolds number differences. Therefore a methodology to extrapolate the wind tunnel test result to flight conditions is discussed. ESA

N92-29204# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

NARSIM: A REAL-TIME SIMULATOR FOR AIR TRAFFIC CONTROL RESEARCH

W. DENBRAVEN and J. M. TENHAVE 25 May 1990 58 p Submitted for publication
 (NLR-TP-90147-U; ETN-92-91537) Avail: CASI HC A04/MF A01

The lack of capacity and efficiency in the present day air transportation system is noted. Developments towards a future integrated Air Traffic Management (ATM) system were initiated in order to reduce these deficiencies. Real time Air Traffic Control (ATC) simulators, such as the NLR ATC Research Simulator (NARSIM), will play an essential role in the research on this future ATC, thus describing the area of interest for ATC research

09 RESEARCH AND SUPPORT FACILITIES (AIR)

simulation. NARSIM is described. Its functions are characterized, followed by a description of the air traffic controller's work environment, the hardware configuration, and the controller workstations. An introduction to NARSIM's main research areas, which are integrated ATM and the man machine interface, is given. ESA

N92-30769# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON PILOTED SIMULATION EFFECTIVENESS [L'EFFICACITE DE LA SIMULATION PILOTEE]

A. G. BARNES (Barnes, A. G., Lytham Saint Annes, England) Apr. 1992 17 p In FRENCH Symposium held in Brussels, Belgium, 14-17 Oct. 1991

(AGARD-AR-315; ISBN-92-835-0669-3) Copyright Avail: CASI HC A03/MF A01

This report evaluates the AGARD Flight Mechanics Panel Symposium on Piloted Simulator Effectiveness, held from 14 to 17 Oct. 1991, in Brussels, Belgium. The intention of the Symposium was to assess the benefits and the future potential of flight simulation in contributing to aircraft development, skill training, and mission training, for both fixed wing and rotary wing aircraft. In particular, contributors were asked to compare the results of simulated and real tasks. The papers were wide ranging and of high quality; several new ideas emerged. The technology of flight simulation has greatly improved since the last symposium on this topic, in 1985. The emphasis of work related to fixed wing aircraft has shifted towards systems integration. A greater contribution to helicopter design and clearance is also evident. Although new visual display devices show great promise for military flight training at high speed, low level, they are not yet fully proven, and it is recommended that an early return is made to the topic of pilot training. Simulator validation and fidelity are also of growing importance. Author

N92-32734# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

INTEGRATION OF WALL INTERFERENCE ASSESSMENT AND WALL ADAPTATION

J. SMITH 25 Mar. 1991 13 p Presented at the International Conference on Adaptive Wall Wind Tunnel Research and Wall Interference Correction, Xian, China, 10-14 Jun. 1991 Previously announced in IAA as A91-52782

(NLR-TP-91119-U; ETN-92-91998) Avail: CASI HC A03/MF A01

The fact that the normal velocity distribution on the test section walls suffices to calculate the associated harmonic perturbation flow field inside it is fully exploited for adaptive wall applications. It is shown to provide a key to test section design. In addition, wall adaptation is applied to obtain correctable, instead of zero, interference. Wall interference assessment is applied to determine, in succession, initial and residual interference. A major advantage of accepting correctability is that deviations of the center of the test section exit from the nominal test section center line, which may give rise to unnecessarily high losses in the diffuser entry area, are avoided. ESA

N92-70563 National Aerospace Lab., Amsterdam (Netherlands). SELECTION OF A LASER ANEMOMETER TECHNIQUE FOR PROPELLER TESTS IN WIND TUNNELS

J. W. KOOL and J. H. M. GOODEN 26 May 1988 14 p Presented at the 24th AIAA/ASME/SAE Joint Propulsion Conference and Exhibit, Thrust for the 21st Century, Boston, MA, 11-14 Jul. 1988 Previously announced in IAA as A88-44735 Sponsored by Nederlands Inst. voor Vliegtuigontwikkeling en Ruimtevaart, Delft

(PB92-138510; NLR-MP-88032-U) Avail: CASI HC A03/MF A01

A commercially available laser Doppler and laser transit anemometer were based in a comparative way to measure the flow field of a 732 m diameter six-bladed propeller. The tests were performed in the NLR low speed wind tunnel which has a

3.0 x 2.25 sq m test section. Free stream velocity was 40 m/s and the propeller rotational speed was selected to be either 3500 or 6000 r.p.m. Both laser anemometers were two component systems, and during the flow field surveys in front of, in between and behind the propeller blades, the axial and tangential velocity components were measured. The results of the two systems were found to be within 1.4 m/s of each other. The LDA angular resolution proved to be better and showed significant flow details which were missed by the LTA. The LTA underlined its well known advantage of high light concentration in the spots. Both systems performed flawlessly and proved their capacity to work in an industrial environment. The LDA had about a three times larger productivity than the LTA system. Author

N92-70574 National Aerospace Lab., Amsterdam (Netherlands). CORRECTION FOR WALL INTERFERENCE IN A SOLID-WALL WIND TUNNEL USING SPARSE MEASURED BOUNDARY CONDITIONS

T. E. LABRUJERE 10 Jan. 1989 25 p

(PB92-138577; NLR-TP-89004-U) Avail: CASI HC A03/MF A01

A method is described, which is the result of further work on a measured boundary condition method developed at NLR, aiming at on-line application. The method requires a minimum of measured tunnel wall pressures and applies a fast algorithm for the calculation of the wall interference. Some numerical test results are discussed. Author

N92-70983 National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

LARVE: A HYPERSONIC FLIGHT TEST FACILITY LAUNCHED BY ARIANE 4

R. HAGMEIJER and K. J. SUDMEIJER (Fokker Space and Systems, Amsterdam, Netherlands) 1 Mar. 1989 21 p Presented at the First European Workshop on Flight Opportunities for Small Payloads, Frascati, Italy, 8-10 Feb. 1989 Sponsored by ESA Previously announced as N89-29445

(Contract NIVR-02803-N)

(PB92-138726; NLR-TP-89279-U) Avail: CASI HC A03/MF A01

A review of the main problems in hypersonic aerothermodynamic and aerodynamic research is presented. To develop useful design tools for reentry vehicles, a balanced combination of CFD codes (Computational Fluid Dynamics), wind tunnel experiments, and free flight tests is needed. A flight test facility that fits into the present need can be simple and cost effective when flown as piggyback in the second stage of Ariane 4. GRA

12

ASTRONAUTICS (GENERAL)

A92-11881

SOVIET SPACE AT THE CROSSROADS

LUCIEN VAN DEN ABELEN Spaceflight (ISSN 0038-6340), vol. 33, Nov. 1991, p. 387-390. refs

Copyright

New space projects planned for the next decade by Soviet scientists and engineers focusing on the exploitation of microgravity and the unique vantage point offered by space-based platforms are presented. Studies of natural resources and earth observation are planned in the framework of an international program. Consideration is given to various other projects involving geophysical experiments, biology, technology and biotechnology, and space technology. R.E.P.

A92-12433

THE DEVELOPMENT STATUS OF THE SPACE TECHNOLOGY RESEARCH VEHICLE

D. G. FEARN, R. D. GOULD, and K. A. RYDEN (Royal Aerospace

Establishment, Space Dept., Farnborough, England) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 18 p. Research supported by Ministry of Defence Procurement Executive. refs
(IAF PAPER 91-008) Copyright

In order to test in orbit a wide variety of new systems and technologies, and to carry out associated research, the Royal Aerospace Establishment is developing two small 50-kg satellites, designated Space Technology Research Vehicles 1a and 1b. They are scheduled to be launched into the geostationary transfer orbit by an Ariane 4 in 1993; in this orbit they will be able to investigate the effects of a very high radiation dose, atomic oxygen erosion, and spacecraft charging. The paper discusses the design of the spacecraft and describes the development status as at September 1991. Details are also given of a selection of the payload experiments. Author

A92-12508

CONCEPT OF A EUROPEAN WIDE GROUND INFRASTRUCTURE FOR EXPERIMENTATION IN THE COLUMBUS ELEMENTS ATTACHED LABORATORY AND FREE FLYER

T. ANDERSEN, N. EILERSEN (DAMEC Research A/S, Copenhagen, Denmark), H. T. BLUME, H. DUWE, M. GAIDA, M. HERTEN (DLR, Cologne, Federal Republic of Germany), M. BROUWER (Nationaal Lucht- en Ruimtevaart Laboratorium, Emmeloord, Netherlands), L. D'ANGELO (MARS Centre, Naples, Italy), R. HENDERSON (RSI, Pfungstadt, Federal Republic of Germany), D. HERMANSEN (Norsk Romsenter, Oslo, Norway) et al. IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs
(IAF PAPER 91-105) Copyright

The layout of the European ground structure for the experiments by Columbus elements in the Space Station Freedom Attached Laboratory and Free Flyer is described. The flexible and dynamic concept of this structure is based on a network of Utilization Centers covering all necessary support functions, which are distributed over all participating nations in Europe. The Utilization Centers are embedded into the broader scope of Columbus utilization by participating in their National User Support Organizations (N-USOs). I.S.

A92-17804#

SWEDEN AND THE SPACE PLANE - A SMALL COUNTRY WITH HIGH AMBITION

P. I. NOBINDER (Swedish National Space Board, Solna, Sweden) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 5 p. Research supported by Swedish National Space Board.
(AIAA PAPER 91-5005) Copyright

The paper gives an overview of the ongoing space plane activities in Sweden. The two projects discussed are the ESA project Hermes and the German project Saenger. Swedish industry and the Swedish Aeronautical Research Institute are engaged and their work is financed by the Swedish National Space Board. Author

A92-17852#

THE UNITED KINGDOM PERSPECTIVE ON THE APPLICATIONS OF AEROSPACE PLANES IN THE 21ST CENTURY

R. C. PARKINSON and R. W. LONGSTAFF (British Aerospace /Space and Communications/, Ltd., Stevenage, England) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 9 p. refs
(AIAA PAPER 91-5084) Copyright

A review of the probable requirements for a space launch vehicle with relatively low recurring flight costs, based on studies of the Hotol system, is presented. Various missions that could benefit from such a system are suggested and how spacecraft design may become more affordable as a consequence is discussed. Introduction of a low-cost, reusable launch vehicle with a payload capacity in LEO of about seven to ten tons could be

expected to encourage a growth in launch demand, both in the present area of communication satellite launch services and in new areas such as a LEO manned space infrastructure. R.E.P.

A92-20644

USE OF NATURAL COMETARY ORBITS FOR SPACECRAFT TRANSFER TO CIS-OORT-SPACE

K. B. SERAFIMOV (Bulgarian Academy of Sciences, Bulgarian Astronautical Society, Sofia, Bulgaria) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs
(IAF PAPER 91-719) Copyright

An approach to spacecraft transfer from the earth to the Oort sphere by debarking a space station on the surface of suitable comets in their orbital part upon leaving the solar system is developed. Upon leaving the solar system, high speed could be achieved by very low energy consumption. The critical elements of the suggested scheme include: (1) obtaining the minimum difference between the comet and spacecraft velocities; (2) protection of the hard component of the cometary matter which can be obtained by solving problem (1), approaching the comet from the sunlit side, and by the special design of the spacecraft; and (3) soft landing on the cometary surface if (1) and (2) are fulfilled and the cometary conditions at the time of leaving the solar system are normal. O.G.

A92-32451

COLUMBUS VII - SYMPOSIUM ON SPACE STATION UTILIZATION, 7TH, ANACAPRI, ITALY, JULY 1-6, 1991, PROCEEDINGS

Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, 155 p. For individual items see A92-32452 to A92-32470.

Copyright

Topics presented include an overview of the Columbus program, a synthesis of the different aspects of Columbus utilization, Space Station program status, an overview of human physiology in microgravity, and requirements and needs in the field of materials science in space. Also presented are the Columbus Attached Laboratory capabilities, the status and prospects of the microgravity laboratories for Columbus, automation and robotics for Columbus utilization, and European external payloads on Columbus and SSF. R.E.P.

A92-32465

COLUMBUS USER SUPPORT ORGANIZATION CONCEPT IN ITALY

A. LORIA (ASI, Rome, Italy), C. MIRRA, and L. D'ANGELO (Microgravity Advanced Research and Support Center, Naples, Italy) (Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings. A92-32451 12-12) Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, p. 213-218. refs

Copyright

A review is presented of work currently being done by the Italian Space Agency with support from the Microgravity Advanced Research and Support Center for Columbus utilization in Italy. At the operating level Italy is planning to exploit some already existing facilities to establish the user support infrastructure necessary to support users in all the disciplines of interest. Attention is given to the national user support concept, an overview of national centers, and a national user support scenario. R.E.P.

A92-32466

USO CONCEPT IN THE MEMBER STATES - BELGIUM

M. C. LIMBOURG (Bruxelles, Universite Libre, Brussels, Belgium) (Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings. A92-32451 12-12) Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, p. 221-224.

Copyright

The Belgian interest in space activities is reviewed with particular emphasis placed for scientific space research. Consideration is

12 ASTRONAUTICS (GENERAL)

given to Belgian participation in Columbus, the Belgian Institute of Space Aeronomy, development of a space research program in light of Columbus utilization, and the Belgian user support organization. R.E.P.

A92-32467

USO CONCEPT IN THE MEMBER STATES - THE NETHERLANDS

F. B. VISSER (National Aerospace Laboratory, Emmeloord, Netherlands) (Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings. A92-32451 12-12) Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, p. 225-227. Research supported by Netherlands Agency for Aerospace Programs.

(Contract ESA-9465/91/F/HEW)

Copyright

User support for microgravity experimentation is currently under development in The Netherlands. A national User Support Organization is emerging, based on a central Dutch Utilization Center (DUC) at the NLR premises in the Northeast Polder, and several 'locations of expertise' and 'locations of facilities' at national industries, national research laboratories, or at ESTEC. The initial development of the Dutch User Support Organization is foreseen to be performed in parallel with the development and implementation of Dutch experiments in the Columbus precursor missions, thereby setting a target for user support as well as a time scale for the availability of user support. Author

A92-32469

SWEDISH USER SUPPORT FOR COLUMBUS

ERIK TILLBERG and CHRISTIAN LOCKOWANDT (Swedish Space Corp., Solna, Sweden) (Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings. A92-32451 12-12) Space Technology - Industrial and Commercial Applications (ISSN 0892-9270), vol. 12, April 1992, p. 235-238.

Copyright

A review is presented of the national user support organization currently under development in Sweden to support experimenters and payload developers in their Columbus and related activities. From the user support and operations center and the interconnected user home bases it will be possible to perform experimental operations of payloads accommodated inside multiuser facilities and operation of experiments utilizing dedicated hardware. The functions of the user support and operations center also include administration, familiarization, and verification support to both the payload developers and experimenters. R.E.P.

A92-33401

SPACECRAFT SYSTEMS ENGINEERING

PETER W. FORTESCUE, ED. and JOHN P. W. STARK, ED. (Southampton, University, England) Chichester, England and New York, John Wiley and Sons, 1991, 442 p. For individual items see A92-33402 to A92-33418.

(ISBN 0-471-92794-5) Copyright

The present volume on spacecraft systems engineering discusses the space environment and its effects on spacecraft design, the dynamics of spacecraft, and celestial mechanics. Attention is given to mission analysis, propulsion systems, launch vehicles, and atmospheric reentry. Topics addressed include spacecraft structure, attitude control, electrical power systems, and thermal control of spacecraft. Also discussed are telecommunications, telemetry and command, ground control, spacecraft electromagnetic compatibility engineering, and product assurance. P.D.

A92-33403

THE SPACE ENVIRONMENT AND ITS EFFECTS ON SPACECRAFT DESIGN

JOHN P. W. STARK (Southampton, University, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 9-31. refs

Copyright

The nature of the spacecraft's environment and the implications that it has on spacecraft design is examined by considering both the way materials behave and the way in which systems as a whole are influenced. The implications for manned spacecraft are examined. Careful environmental control of components and subsystems during prelaunch periods is argued to be essential if degradation of the spacecraft system as a whole is to be avoided. Attention is given to the steady component of launch acceleration, mechanical shock, and the thermal environment experienced during launch. The space and near-earth environments are discussed. The effects of zero or microgravity on man are examined. They include: blood volume redistribution, muscular atrophy, vestibular problems, and cumulative bone decalcification. P.D.

A92-36073

AUSTRALIAN SPACE - LOOKING FOR A DIRECTION

PHILLIP S. CLARK Space (ISSN 0267-954X), vol. 8, no. 2, Apr.-May 1992, p. 6-8, 10-12. refs

Copyright

The results of a conference regarding the future of the Australian space program are reported with extensive references given to past and ongoing space programs. Descriptions are given of the Australian Space Office, scientific research organizations, space-science activities, remote-sensing projects, and the development of the Endeavour Telescope. The capacity for Australian space activities is examined in terms of satellites, satellite communications, the processing of satellite imagery, and launch vehicles. Projects that are in the beginning stages include the Southern Launch Vehicle, a Lightsat space platform, and a telecommunications satellite Aussat C with Ku-, C-, and L-band capabilities. Cooperation between private companies and government agencies is shown to be important for the development of these programs, and some indications of such collaboration are reported. C.C.S.

A92-39510

THE SPACE EXPLORATION INITIATIVE AND THE AERO-SPACE PLANE LAUNCHER

RUSSELL J. HANNIGAN (Ecole Polytechnique, Paris, France) and DAVID C. WEBB (International Hypersonic Research Institute, Winter Springs, FL) IN: Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1991, p. 2-27 to 2-36. refs

Copyright

The critical operational requirements of the Space Exploration Initiative (SEI) are examined to compare the use of heavy-lift launch vehicles (HLLVs) and aerospace plane launchers (ASPLs). Earth-to-orbit launch systems are shown to require high levels of failure resilience and continuous access which are not easily achievable with the expendable vertically launched HLLVs. A dual-launch architecture is proposed for the SEI lunar-base segment which combines the use of the HLLVs and fully reusable ASPLs, and attention is given to the specific application of each type of launch vehicle. The payloads related to SEI elements are outlined including the Space Transfer Vehicle, the Manned Lunar Lander, and the Cargo Lunar Lander. The optimized scenario for the combined ASPL/HLLV architecture can provide good resiliency, flexibility, and operations that ensure continuous access to space and minimize the impacts of stand-down periods. C.C.S.

A92-46468

LEOSTAR - A SMALL SPACECRAFT FOR LEO COMMUNICATIONS MISSIONS

G. BARRESI, G. RONDINELLI, C. SODDU (Ital Spazio S.p.A., Rome, Italy), and D. L. BROWN (ESTEC, Noordwijk, Netherlands) IN: Annual AIAA/Utah State University Conference on Small Satellites, 5th, Logan, Aug. 26-29, 1991, Proceedings. Logan, UT, Utah State University, 1991, 12 p.

LEOSTAR is a three-axis gravity gradient stabilized satellite, able to support two-way data message communications and position reporting with a multisatellite constellation. An extensible boom, together with three orthogonal magnetic torquers and an on-board dedicated computer, provides attitude stabilization.

Thrusters provide the station keeping and transfer maneuvers according to an optimized strategy. A bipropellant system with monomethyl hydrazine as propellant and nitrogen tetroxide as oxidizer is used. Satellite functions and operation management are performed by two on-board processors which can be programmed for each mission and configuration. The communications payload power/mass range from 100 W/40 kg to 200 W/60 kg. A payload volume of 0.12 cubic m and a maximum antenna dimension of 1 m are allowed. LEOSTAR is designed to be compatible with both Scout and Pegasus launchers in single or double launch configurations. It can also be launched by large vehicles such as Ariane 4 and Delta in cluster and/or piggyback mode. A.F.S.

A92-53430

SOLAR SAIL EXPEDITION TO THE MOON AND MARS - MISSION UPDATE

ROBERT L. STAEHLE, JOHN M. GRAHAM, and JOHN CHAMPA Spaceflight (ISSN 0038-6340), vol. 34, no. 8, Aug. 1992, p. 256-258.

Copyright

The present status of the planned solar sail races to the moon and Mars is discussed. The launch and sail configurations and avionics systems to be used in the races are described. Plans to use race strategy as an educational tool are addressed. C.D.

A92-53452

THE SWEDISH SPACE PROGRAM

ARNE HELGER (Swedish Space Corp., Kiruna, Sweden) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 3-11.

Copyright

The main Swedish space organizations and projects are briefly reviewed. The main responsibilities of the Swedish National Space Board and Swedish Space Corporation are outlined and the government space budget is presented for fiscal years 1987-1990. The main objectives of the Swedish national scientific program are listed in their relationship to space efforts, and the participating institutes are given. The Viking, Freja, and Promics satellites are discussed. Swedish remote sensing efforts and participation in international efforts are addressed. C.D.

A92-53453

THE NORWEGIAN SPACE PROGRAMME

ARNE GUNDERSEN (Norwegian Space Centre, Oslo, Norway) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 13-22.

Copyright

A brief survey of the Norwegian space program is presented. The scientific and technological goals of the program are outlined. Space-related activities at the Andoya rocket range and the Tromsø satellite station are described. C.D.

A92-53457

SPACE ACTIVITIES IN ITALY

CARLO BUONGIORNO (ASI, Rome, Italy) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 47-52.

Copyright

A brief review is presented of the Italian national space program and Italian participation in international space programs. The most important of these programs are listed along with the participants. C.D.

A92-53458

THE FRENCH SPACE PROGRAMME

BERNARD LUCIANI (CNES, Paris, France) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing,

Inc., 1990, p. 53-60.

Copyright

The organization and activities of the French space program are discussed. The French telecommunications and TV broadcasting satellites are discussed, including the Telecom series and CNES, the SPOT earth observing satellite, the data collection and platform location Argos system, Ariane, and Hermes. Budgetary considerations are addressed. C.D.

A92-53459

EUROPEAN SPACE AGENCY - ACHIEVEMENTS AND PERSPECTIVES

MAURICE DELAHAIS IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 61-70.

Copyright

The reasons for the European commitments to space are reviewed, and the aims and structure of ESA are described. Attention is given to ESA efforts in space science, earth observation, telecommunications, commercial space ventures, and manned spaceflight. The European long-term space plan is summarized, and the roles of autonomy and cooperation in fulfilling ESA's long-term goals are briefly examined. C.D.

A92-53774

ARIANE MICROGRAVITY CAPSULE - RETRIEVABLE SPACECRAFT FOR RESEARCH, IN-ORBIT TESTING AND PREPARING OF COMMERCIAL UTILIZATION

J. KLUG (MAN Technologie AG, Munich, Germany) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2271-2280.

Copyright

An Apollo-shape spacecraft compatible with the Ariane 4 and 5 launcher is proposed for microgravity research and in-orbit testing activities in LEO. The Ariane capsule fully meets needs concerning volume and power supply. It allows a consequent continuation of former projects as well as the urgent preparation for the Columbus utilization. A payload mass of 400-900 kg in a volume of 3 cu m can be accommodated by the availability of 700 W electric energy provided by solar arrays, during a mission duration of 7 to 21 days in a micro-g environment. The Ariane capsule is designed as an auxiliary payload on the powerful and cost efficient launcher Ariane and its associated ground facilities. Author

A92-55827

COMMUNICATE SPACE: A COMPARISON OF TWO CASE HISTORIES - EUROPE AND USA

CLAUDIO BORGONOV (Roma, Università, Rome, Italy) and LAURA BOGANI (Bogani PR International, Italy) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs

(IAF PAPER 92-0502) Copyright

The role of corporate public relations in national space programs is examined. The public relations efforts of companies in individual European countries and in the United States are compared. C.D.

A92-55842

MANNED MISSIONS TO MARS - WHAT SCENARIOS FOR EUROPE?

FRANCIS THEILLIER, CORINNE BRISON (Aerospatiale, Les Mureaux, France), UWE APEL (ERNO Raumfahrttechnik GmbH, Bremen, Germany), MARIA A. PERINO (Alenia Spazio S.p.A., Turin, Italy), and DAVE SALT (British Aerospace, PLC, Stevenage, United Kingdom) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 14 p. refs

(IAF PAPER 92-0534) Copyright

The highlights of a recent study sponsored by the ESA to identify possible scenarios and related infrastructure requirements for manned missions to Mars are reviewed. In particular, attention is given to Mars mission objectives and main constraints, including

12 ASTRONAUTICS (GENERAL)

orbital mechanics, human factors, technology, operations, and costs. The discussion also covers general mission architectures, international cooperation, and European interests. V.L.

A92-57189

UNMANNED ORBITAL SERVICING - FROM GROUND TESTS TO IN-ORBIT DEMONSTRATION

U. BECKER and W. RATH (ERNO Raumfahrttechnik GmbH, Bremen, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 12 p. refs (IAF PAPER 92-0780) Copyright

An overview is presented of the ERNO activities in the field of unmanned in-orbit servicing technology development, the long-term goal of which is a flight of a mission called Demonstration of Unmanned Servicing Element (DUSE). The candidate design of the DUSE flight demonstrator is presented together with results of the mission feasibility analysis and programmatic aspects. I.S.

N92-24594# Norwegian Space Center, Oslo.

THE NORWEGIAN SOUNDING ROCKET AND BALLOON PROGRAMME

ARNE GUNDERSEN and BO N. ANDERSEN /In ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 27-34 Nov. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The status and development of the Norwegian sounding rocket and balloon program is presented with emphasis on the national scientific activities. The majority of the activities consist of launches from the Andoya rocket range. The launches are intended to investigate processes in the middle and upper atmosphere. The in situ measurements are supplemented by a large number of ground based support instruments. The ongoing and planned projects are described in some detail and the highlights of the latest completed projects are given. The overall program for the period 1991 to 1994 is reviewed. ESA

N92-24719# European Space Agency, Paris (France).

SPACECRAFT FLIGHT DYNAMICS

JAMES J. HUNT, ed. Dec. 1991 596 p The 3rd international symposium was held in Darmstadt, Fed. Republic of Germany, 30 Sep. - 4 Oct. 1991 (ISSN 0379-6566)

(ESA-SP-326; ISBN-92-9092-146-3; ETN-92-91274) Copyright Avail: CASI HC A25/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The papers from sessions on the following are presented: geostationary co-location; celestial mechanics; accuracy and precise estimation; orbit related experience; attitude related experience; geostationary mission aspects; spacecraft dynamics and control; more than one spacecraft; mission and orbit design; mission descriptions. The variety of topics and the range of institutes represented testify to the wide scope and ever changing nature of flight dynamics. Operational experience plays a dominant role and is reflected in the number of papers chosen from this area. The broad program closed the circle joining theory, design and experience.

ESA

N92-24777# European Space Agency. European Space Operations Center, Darmstadt (Germany).

CLUSTER: FUEL OPTIMUM SPACECRAFT FORMATION CONTROL

J. SCHOENMAEKERS /In its Spacecraft Flight Dynamics p 419-425 Dec. 1991

Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The Cluster mission, an in situ investigation of the Earth's magnetosphere using four spacecraft simultaneously, is reported. Its objective is the accurate determination of three dimensional and time varying phenomena. The launch is planned for 1995 and the scientific operations are to last about two years. The spacecraft is to be placed in nearly identical highly eccentric polar

orbits such that once per orbit, when crossing a region of scientific interest, they all are at the vertices of a tetrahedron with predefined separation distance. The region where the tetrahedron is formed and the relative separation is to be changed regularly during the mission. A method to calculate the trajectory maneuvers to establish, modify and maintain the tetrahedron flight configuration was developed. An alternative to this method is presented and the results of both methods are compared. ESA

N92-27008# Futuro S.R.L., Florence (Italy).

MULTI-CULTURAL COMPONENTS AND KEYS FOR EUROPEAN WORLDWIDE SPACE PROGRAMS

ROBERTO PINOTTI /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1021-1023 Dec. 1991

Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The role of different cultures in space missions is considered with regard to NASA and ESA astronauts and Russian cosmonauts. The identification of all the psychological and socio-anthropological components in the behavior of human groups in space is extremely important to understand and solve different problems and obtain the mission's success. In this light, the creation of a multicultural atmosphere aboard is considered a positive aspect for future space programs, and the synthesis of European cultural elements is a definite key to develop morale and productivity. ESA

N92-29879# European Space Agency, Paris (France).

FOURTH MEETING OF THE SPACE AGENCY FORUM ON THE INTERNATIONAL SPACE YEAR (SAFISY-4)

T.-D. GUYENNE, ed. Dec. 1991 156 p Meeting held in Moscow, USSR, 16-17 May 1991

(ESA-SP-1141; ISBN-92-9092-140-4; ETN-92-91388) Copyright Avail: CASI HC A08/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The SAFISY-4 meeting report contains: a report on the SAFISY status, contributions to ISY by SAFISY members, reports of panels of experts, USSR's contribution to ISY, preparation of 1992 events, reports of associations and research groups, and post-1992 collaboration in SAFISY projects. The meeting is aimed at the preparation of the International Space Year, to promote cooperation of a wide circle of specialists and public figures in the interest of in depth studies of the planet Earth. ESA

N92-70627 European Space Agency, Paris (France).

SPACE: PART OF EUROPE'S ENVIRONMENT

1992 40 p Original contains color illustrations

Avail: CASI HC A03; 37 functional color pages

From space, man has seen the Earth as a hospitable planet of great beauty and fertility in a seemingly very bleak environment. This space environment is nevertheless one of our potentially richest fields of exploration and exploitation. It enables us not only to extend the frontiers of human knowledge about the planet on which we live and the solar system in which it exists, but also to use space to meet man's practical needs in an increasingly complex society. In Europe today, both these challenges are being met. A comprehensive look at the European Space Agency's program is presented. Author

13

ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

A92-15808

ANALYSIS OF THE RESONANCE ANGLE OF COSMOS 1603 (1984-106 A) NEAR 14:1 RESONANCE

P. MOORE and M. S. GILTHORPE (Aston University, Birmingham,

England) Planetary and Space Science (ISSN 0032-0633), vol. 39, Nov. 1991, p. 1549-1558. Research supported by SERC and Ministry of Defence of England. refs
Copyright

During 1987 the near-circular orbit of the USSR satellite Cosmos 1603 (1984-106 A) was strongly perturbed by 14th-order resonance terms in the earth's gravity field. Due to near minimum solar activity, aerodynamic effects were subsidiary to resonance to the extent that, in a previous paper, lumped harmonics were recovered from the mean motion. The study is now taken a step further with lumped harmonics sought from the variation of the resonance parameter, Φ . An analytical expression is developed for the variation of Φ with time due to the principal resonance term and then extended to include the second-order resonance effect. Airdrag is modelled by a small correction term. Lumped harmonics of order 14 and 28 are extracted from the resonance variable and compared against previous values from Cosmos 1603 and those from global gravity fields. Author

A92-15818
APPLICATION OF A SATELLITE AERODYNAMICS MODEL
BASED ON NORMAL AND TANGENTIAL MOMENTUM
ACCOMMODATION COEFFICIENTS

P. MOORE and A. SOWTER (Aston University, Birmingham, England) Planetary and Space Science (ISSN 0032-0633), vol. 39, Oct. 1991, p. 1405-1419. refs
Copyright

Tangential and normal momentum-accommodation coefficients are reviewed as a parametrization of the gas-surface interaction for modeling aerodynamic forces on artificial earth satellites. By reference to experimental data and other studies, a simple empirical relationship for the normal momentum coefficients is deduced while the tangential coefficient is taken to be invariant with the angle between the incident stream and the surface normal. Parameters within these coefficients are estimated by least-squares reduction of orbital elements of ANS-1 (1974-70A). Derived results yield a drag coefficient for a sphere of 2.5 ± 0.03 , which is less than 10 percent below the accepted values of 2.2 for heights near 300 km. Author

A92-18606
DYNAMICS OF A TETHERED SATELLITE SUBJECTED TO
AERODYNAMIC FORCES

GUIDO DE MATTEIS and LUCIANO M. DE SOCIO (Roma I, Università, Rome, Italy) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 14, Nov.-Dec. 1991, p. 1129-1135. Research supported by MPI. Previously cited in issue 06, p. 772. Accession no. A90-19970. refs
Copyright

A92-33286#
EXPLICIT GUIDANCE LAW FOR MANNED SPACECRAFT

M. DELPORTE and F. SAUVINET (Aerospatiale, Division des Systemes Strategiques et Spatiaux, Les Mureaux, France) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 11 p. refs
(AIAA PAPER 92-1145) Copyright

The paper presents a closed loop guidance law for the exoatmospheric trajectory of a launch vehicle. This algorithm has been especially developed for manned mission. The main objectives of this investigation were optimization, accuracy and reliability. Another great issue was to reduce the mission analysis. The explicit guidance generates onboard the optimal path to the desired orbit while optimizing fuel consumption, and respecting some constraints. The computation of the steering law is based on an analytical integration of the trajectory which is divided in a little number of segments. Intermediate constraints such as thermal flux, stage footprint, radar visibility, are applied at the end of the segments. At the final point five orbital parameters are targetted. The steering law parameters are updated at each guidance cycle to cancel predicted constraint errors, using a linear differential correction method. Simulations tested this algorithm with respect

to accuracy, optimization, reconfiguration capability. Results are very good compared with off-line optimization. Author

A92-33404
DYNAMICS OF SPACECRAFT

PETER W. FORTESCUE (Southampton, University, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 33-58.
Copyright

An overview of the dynamics of spacecraft bodies is presented, and a framework for the subjects of celestial mechanics and for attitude control is set. Newtonian dynamics is used to provide a sufficient means of forecasting and understanding a spacecraft's behavior. The dynamics of both translation and rotation is expressed in terms of the appropriate form of momentum - linear or angular. Momentum makes it possible to readily determine the consequences of forces or moments. The momenta are interpreted in terms of the physical movement - the velocities, linear and angular. Terms which are associated with mass distributions are defined, and formulas which are useful for the evaluation of the inertia matrix are presented. P.D.

A92-33409
ATMOSPHERIC RE-ENTRY

ROBIN A. EAST (Southampton, University, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 175-194. refs
Copyright

Atmospheric reentry and aero-assisted orbited transfer are discussed. The aerodynamic features of the range of atmospheric braking and maneuvering space vehicles are determined by the velocity-altitude regime of the atmospheric flight. A comparison of the flight regimes of several of the vehicles proposed for earth atmosphere encounters is presented. A typical entry altitude where the 'top' of the earth's atmosphere is encountered (about 150 km). The bulk of the trajectories for the Space Shuttle orbiter, Apollo reentry, ICBM, and AMOOS lie within the continuum flow regime. For AOTVs and plane change vehicles, a significant fraction of the atmospheric encounter occurs in a very energetic rarefied flow regime. Chemical nonequilibrium effects, radiative heat transfer, and air ionization are phenomena which have a major influence on AOTVs. Ballistic entry at large angles of descent, lifting entry, thermal protection systems, and the entry corridor are discussed. P.D.

A92-41764
RE-ENTRY AERODYNAMICS DERIVED FROM SPACE DEBRIS
TRAJECTORY ANALYSIS

R. CROWTHER (Royal Aerospace Establishment, Farnborough, England) Planetary and Space Science (ISSN 0032-0633), vol. 40, no. 5, May 1992, p. 641-646. refs
Copyright

This paper considers the technique of orbital analysis as a means of determining the ill-defined gas-surface interaction between spacecraft and atmospheric molecules in low earth orbit. The interaction is a major uncertainty in trajectory predictions for a body moving within an atmosphere. The rate of change of the orbital period of a debris object, the uncontrolled Salyut 7/Kosmos 1686 space station, is analyzed in order to determine the free molecular drag coefficient. The results are compared with theoretical values for the drag coefficient calculated using a complex representation of the vehicle configuration and motion and applying the Monte Carlo Test Particle method. Results suggest a nature of re-emission very close to the classical diffuse, totally accommodated case was occurring at the surface of the debris object as it approached re-entry. However, the determined drag coefficient and therefore the derived interaction are found to be very sensitive to the neutral density and therefore the atmospheric model used in the analysis. Author

A92-43262
APOGEE MANOEUVRE STRATEGIES FOR THE INMARSAT-2
SPACECRAFT

ERIC CAZALA-HOURCADE (CNES, Toulouse, France) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 1. San Diego, CA, Univelt, Inc., 1992, p. 161-183. refs (AAS PAPER 91-364) Copyright

Several methods are employed to calculate orbital corrections that are needed to analyze the mission and operations of the Inmarsat-2 spacecraft. Particular attention is given to the inclined drift orbit for the final apogee engine firing and the apogee bias of the Delta II transfer orbit. The optimal switching conditions are solved in the preliminary phases of the mission analysis to determine the transfer cost. This allowed the determination of the domain of validity of the simplified nodal transfer for a given orbital configuration. A strategy for the apogee engine firing is determined for Delta II launchers with consideration given to the orbital inclination, node shifts, and loss of potential drift. The method is extended to scenarios involving Ariane launchers showing that optimal transfers can be used to determine the maximum possible drift for the plane of Inmarsat-2 within its inclination constraint.

C.C.S.

A92-43391

EQUILIBRIUM CONFIGURATIONS IN A TETHERED ATMOSPHERIC MISSION

SILVIO BERGAMASCHI and FABRIZIO BONON (Padova, Universita, Padua, Italy) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 3. San Diego, CA, Univelt, Inc., 1992, p. 2397-2410. refs

(AAS PAPER 91-543) Copyright

When a tethered system is deployed downward, at low orbital altitudes, its equilibrium configurations are affected by the aerodynamic force. The purpose of this paper is to study the shape of the tether, in the assumption that both the departure from local vertical and the tether curvature can be large. Equations of motion first derived by Beletskii and Levin are used and the resulting nonlinear boundary value problem is solved by numerical integration. Results are presented to show the dependence of the tether configuration on system parameters, with particular attention to the cases in which the satellite altitude is close to 100 km.

Author

A92-52080#

OPTIMAL FINITE-THRUST SPACECRAFT TRAJECTORIES

GUIDO COLASURDO (Torino, Politecnico, Turin, Italy) IN: 1992 AIAA/AAS Astrodynamics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 265-269. Research supported by MURST. refs

(AIAA PAPER 92-4510) Copyright

The indirect approach to optimal orbit transfer is presented and adapted to a method that efficiently solves the resulting boundary problem employing the Newton method. Examples of optimal finite-thrust transfer between circular coplanar and noncoplanar orbits are given. It is shown that performance, particularly the computing time, appears very competitive. R.E.P.

A92-52738

FLUID DYNAMIC FORCES ON TETHERED SATELLITE SYSTEMS

N. BELLOMO (Torino, Politecnico, Turin, Italy), N. DE DIVITIIS, and L. M. DE SOCIO (Roma I, Universita, Rome, Italy) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 369-376. Research supported by MURST and CNR. refs

Copyright

This paper deals with the modeling of the fluid dynamic interaction of a molecular gas with an element of the outer surface of a space vehicle in flow conditions which are characterized by a great variation of the Knudsen number. The results are applied to the evaluation of the aerodynamic forces on parts of a tethered satellite system.

Author

A92-53645

CONTROL MODELS FOR ASCENT PERFORMANCE OPTIMIZATION OF AIRBREATHING LAUNCH VEHICLES

ULRICH M. SCHOETTLE (Stuttgart, Universitaet, Germany) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1403-1409. refs

Copyright

Ascent performance evaluations for one- and two-stage launch vehicles using either turbo-rocket-ramjet or ejector-ramjet propulsion systems are presented. The numerical results obtained indicate that the constraints imposed on the ascent portion of a flight can be used to substantially reduce the complexity of the optimization problem; the use of control laws to enforce admissible state boundaries, in place of direct control discretization, allows a factor of 6-10 reduction in problem complexity without compromising the accuracy of the results.

O.C.

A92-55216#

REENTRY CONTROL OF A LOW-LIFT MANEUVERABLE SPACECRAFT

AXEL J. ROENNEKE and KLAUS H. WELL (Stuttgart, Universitaet, Germany) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 641-652. refs

(AIAA PAPER 92-4455) Copyright

Commercial operation of space laboratories will rely on small, unmanned reentry capsules to retrieve experimental products independent from Shuttle services. An example for such a concept is the Space Mail system studied by the ESA. This paper presents a trajectory control system based on linear state feedback to guide and control the reentry glide of low-lifting capsules. A technique to design a time-varying controller is derived and applied. Simulation results of spatial flights over a rotating earth show that the designed controller effectively responds to entry condition offsets on several reference trajectories. Also, the controller is capable of tolerating modified vehicle parameters as well as atmospheric disturbances, and the same controller gain functions are successfully applied to different reference trajectories.

Author

A92-55401#

SOLVING THE AEROASSISTED ORBITAL TRANSFER PROBLEM BY USING A SEQUENTIAL OPTIMIZATION APPROACH

ALF DAUM (DLR, Cologne, Germany) IN: AIAA Atmospheric Flight Mechanics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 819-827. refs

(AIAA PAPER 92-4646) Copyright

A sequential trajectory optimization method (STROM) is presented which is aimed at solving the aeroassisted orbital transfer problem in connection with most realistic physical boundary conditions. The complete exo-/endoatmospheric trajectory of an aeroassisted orbital transfer vehicle is divided into optimized and unoptimized subarcs. At the initial and final point of any subarc, boundary conditions are specified, representing initial, final, or intermediate conditions. The optimal control problem is converted to a nonlinear program by parameterization of the time depending controls. Optimal solutions are presented for a raked-off spherical cone which describe the behavior of state variables and optimization parameters with respect to changing assumptions in the physical models.

O.G.

A92-55516

HERMES NOMINAL REENTRY TRAJECTORIES

D. LEMARIE (Dassault-Aviation, Saint-Cloud, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 11 p. refs

(IAF PAPER 92-0018) Copyright

A design methodology is outlined for hypersonic atmospheric reentry trajectories that allows the optimization of missions such as the space shuttle Hermes. Trajectory design parameters such

as the drag-acceleration profile and the angle-of-attack (AOA) are examined for a specific flight corridor, and optimized reentry is considered in terms of the minimization of thermal effects and the maximization of the cross range. The analysis yields six drag-acceleration profiles for distinct reentry approaches, and attention is given to the minimization of absorbed heat and the optimal values for angle of attack and the drag-acceleration phase level. The maximum single-level AOA profile yields the minimum absorbed heat, while the minimum single AOA profile gives the minimum cross range. A design methodology based on these and other results is formulated that can be applied to the design of the reentry profiles for the desired heat, drag, bank-angle, and AOA results. C.C.S.

N92-23973# Royal Aerospace Establishment, Farnborough (England). Space Dept.

DEBRIS REENTRY PREDICTION: SALYUT-7/KOSMOS-1686

R. CROWTHER *In* ESA, The Reentry of Salyut-7/Kosmos-1686 p 51-56 Aug. 1991

Copyright Avail: CASI HC A02/MF A02

The problems encountered when attempting to predict the reentry of space debris are considered. The King-Hele rate of change of mean motion lifetime prediction method is applied to the reentry estimation of the Salyut-7/Kosmos-1686 complex. Deficiencies in the current status of the method are identified and new data computed to account for these deficiencies. A method is then proposed which can provide aerodynamic data on reentering objects from observation of their orbital evolution. Such data will enable the active deorbiting of objects using aerodynamic techniques as opposed to propulsive strategies which make great demands on the propellant budget. ESA

N92-24774# Royal Aerospace Establishment, Farnborough (England). Space Dept.

LIMITATION OF SPACE DEBRIS IN GEOSTATIONARY TRANSFER ORBIT

R. CROWTHER *In* ESA, Spacecraft Flight Dynamics p 397-402 Dec. 1991

Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The hazard to mission operations posed by space debris in Geostationary Transfer Orbit (GTO) is considered. A number of debris mitigation strategies are considered. These include the harnessing of the luni-solar perturbation to the satellite orbit, atmospheric drag augmentation, and active propulsive deorbit. Results suggest that active deorbit using a dedicated propulsive unit offers the least performance penalty. ESA

14

GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

A92-14708

GROUND OPERATIONS OF A HTOL AIRBREATHING LAUNCHER

JEAN-PIERRE BOMBLED and ANNE TOMATIS (Aerospatiale, Division Systemes Strategiques et Spatiaux, Les Mureaux, France) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 17 p. refs (IAF PAPER 91-217) Copyright

This question of what is necessary to face nominal and contingency scenarios during HOTOL airbreathing space plane flight preparation, take-off, landing, and after landing was examined with the help of functional analysis. This showed that use of hydrogen as fuel creates some important problems during the

preparation of the launcher, the payload, and the crew. This would lead to the necessity of many specific facilities to guarantee safety in nominal and post-abort situations. Surprisingly, post-abort situations add only few requirement for facilities, but they imposed increased complexity (like the use of robotics). These results, added to the requirements of minimizing risk and annoyance to the populations and the air traffic lead to the conclusion that it is not possible to use classical civilian or military airports, and that dedicated bases are necessary. Author

A92-55850

THE TECHNICAL EVOLUTION OF GROUND FLIGHT DYNAMICS SYSTEM UTILIZED FOR SPACECRAFT OPERATIONS

J. P. CARROU, G. CAMPAN, J. FOURCADE, and J. FOLLIARD (CNES, Toulouse, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. (IAF PAPER 92-0546) Copyright

The development of technologies for ground-control systems for space mechanics systems at CNES is reviewed in the context of three experimental stages. The period 1965-74 focused on operational issues such as orbit determination and concepts for mission analysis such as launcher and satellite parameters. The preoperational phase of 1975-86 emphasized the development of satellites and ground-segment support for telecommunications, direct broadcasting, and earth observation. The developments led to the operational and commercial space ventures that characterize current projects, and a computer operation system for station acquisition is described for present satellite activities. A strategy is outlined for coping with the commercialization of space by developing the Oremus computer system which is based on the Mercator system that is demonstrated effective in satellite ground control. C.C.S.

A92-57272

THE HERMES NOMINAL LANDING SITES

E. ROMERO, A. PEREZ DE LABORDA, I. ERCE, and A. ALDAMIZ (Sener Ingenieria y Sistemas, S.A., Las Arenas, Spain) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. (IAF PAPER 92-0884) Copyright

The functions, installations, and main operational aspects that have been defined for the Hermes nominal landing sites are discussed. The landing site infrastructures, landing aids, and facilities for payload, crew, reception, operations, communications, logistics, and SAR are outlined. The typical milestones and tasks performed during each of five operational phases of a typical Hermes mission are described. C.D.

N92-20715# European Space Agency, Paris (France).

LAUNCH BASES AND CONTROL INFRASTRUCTURES FOR SPACECRAFT

BRIGITTE KALDEICH, ed. Oct. 1991 490 p *In* ENGLISH and FRENCH The 4th European Aerospace Conference was held in Paris, France, 13-16 May 1991 (ESA-SP-342; ISBN-92-9092-210-9; ETN-92-91203) Copyright Avail: CASI HC A21/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

Launch bases and spacecraft control centers were addressed. Conference papers are grouped under the following headings: world launch bases; facilities for preparing and launching vehicles; facilities for preparing and integrating payloads (automatic or manned); general coordination of operations on a launch base; safety for persons and property; evolution of the measuring and communications systems needed for launches; industrial support and logistics; control centers and station networks; placing and keeping satellites on station; tracking, measuring and monitoring during missions; ground support for rendezvous and in orbit operations; return sites and means of recovery; control of deorbiting and return to Earth; identification of space debris.

ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

N92-20720# Swedish Space Corp., Esrange.

ESRANGE: SOUNDING ROCKET AND BALLOON FACILITY

ULF HOEGMAN, J. ENGLUND, A. HELGER, A. WIKSTROEM, and LENNART MARCUS /In ESA, Launch Bases and Control Infrastructures for Spacecraft p 29-31 Oct. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

Esrange (Kiruna, Sweden) offers a complete range of services for sounding rocket and balloon launchings to users from all over the world. Experiments carried out include microgravity, geophysics, space physics, astronomy and the chemistry of the upper atmosphere. Data from the extensive network of ground based scientific instruments in northern Scandinavia can be displayed at Esrange. Most types of sounding rockets including high performance vehicles such as Terrier Black Brant and Skylark 12 can be launched. The latest development, MAXUS, offers 15 minutes of microgravity and 1000 km apogee. Balloon payloads up to 500 kg are regularly flown from Esrange. The land recovery operations are very reliable concerning both rockets and balloons. ESA

N92-20726# Centre National d'Etudes Spatiales, Paris (France).

DESIGN EVOLUTION OF THE ARIANE LAUNCHING INSTALLATIONS [EVOLUTION DE LA CONCEPTION DES INSTALLATIONS DE LANCEMENT ARIANE]

MICHEL MIGNOT /In ESA, Launch Bases and Control Infrastructures for Spacecraft p 63-64 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

The evolution of the launching assemblies for Ariane 1, 2 and 3 are described. Launching augmentation, decrease in accident vulnerability, and the search for operational activity optimization constituted the principal work axes, in parallel with a continuous adaptation to evolutions of the Ariane launcher. The Ariane 5 will benefit from one of the most modern and functional ground infrastructures. ESA

N92-20774# Centre National d'Etudes Spatiales, Toulouse (France). Direction du Programme.

HERMES: ASTRONAUT SAFETY DURING LAUNCHING AND REENTRY PHASES [HERMES: SAUVEGARDE DES SPATIONAUTES PENDANT LES PHASES DE LANCEMENT ET DE RENTREE]

JEAN CHARLES /In ESA, Launch Bases and Control Infrastructures for Spacecraft p 393-396 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

The Hermes Manned Spaceplane serves as a shuttle between the Earth and the Columbus Space Station for a crew of three astronauts. The Hermes spaceplane 'concept' incorporates a crew safety logic that determines risks during the critical phases of launch and reentry. The crew safety logic is a function of the possible emergencies, the timing of those emergencies, and the predicted outcome of the emergencies. The possible outcomes are as follows: complete loss, saving of crew with loss of plane, or saving of crew and plane with loss of mission. ESA

N92-20778# Aerospatiale, Les Mureaux (France). Div. Systemes Strategiques et Spatiaux.

CONTROL OF THE DESTRUCTION OF A LOGISTIC VEHICLE AT REENTRY [CONTROLE DE LA DESTRUCTION D'UN VEHICULE LOGISTIQUE A LA RENTREE]

REGIS THEVENOT /In ESA, Launch Bases and Control Infrastructures for Spacecraft p 419-424 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

Research was undertaken to better understand and control the return to Earth of a launch stage. The stage reenters the atmosphere, at high Mach number, after a 'ballistic' flight of variable length. In order to model the behavior of this object during its return to Earth, specific studies were necessary in the following

areas: aerodynamic characterization of the stage in its complete flight domain; clarification of possible equilibrium positions; and reentry trajectory calculations to define a scenario which eliminates lift problems. The approach will be completed by elements which take into account the break-up of the stage and the resulting debris. ESA

N92-20786# Bureau Veritas, Toulouse (France).

OPERATIONAL SAFETY OF A KOUROU (FRENCH GUIANA) ARIANE LAUNCH BASE GROUND SYSTEM [SURETE DE FONCTIONNEMENT D'UN SYSTEME SOL DE LA BASE DE LANCEMENT ARIANE DE KOUROU]

PHILIPPE CAUMES (Aerospatiale, Paris (France).), ALAIN RAGOT (Aerospatiale, Paris (France).), and B. SCHIETECATTE (MATRA Espace, Toulouse, France) /In ESA, Launch Bases and Control Infrastructures for Spacecraft p 483-486 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

The methodology and results of evaluation studies of the operational safety of the Ariane 5 operational control center are presented. The performance of this system in terms of reliability, availability, and security are analyzed. It is determined that the operational safety activities must guarantee the attainment and maintenance of the necessary level through the identification, evaluation, hierarchization, reduction, and acceptance of risks. ESA

15

LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

A92-12560

ARIANE TRANSFER VEHICLE (ATV) - A GENERIC SPACECRAFT

FRANCIS THEILLIER (Aerospatiale, Division Systemes Strategiques et Spatiaux, Les Mureaux, France) and DAVID J. SALT (British Aerospace /Space Systems/, Ltd., Stevenage, England) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-186) Copyright

The main results and conclusions of various analyses of the Ariane Transfer Vehicle (ATV) are discussed. The mission and related operational aspects, cargo requirements, ATV level of autonomy, developmental milestones, and possible missions are reviewed. The status of ATV design is stated. C.D.

A92-14705

ORIFLAMME - A REFERENCE AIRBREATHING LAUNCHER TO HIGHLIGHT AREAS THAT ARE TECHNOLOGICAL DRIVERS FOR HYPERSONIC VEHICLES

ALAIN WAGNER and JEAN-PIERRE BOMBLED (Aerospatiale, Division Systemes Strategiques et Spatiaux, Les Mureaux, France) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 26 p. refs (IAF PAPER 91-207) Copyright

The paper describes the design and operation principles of Oriflamme, an SSTO concept of an airbreathing launcher, the powerplant of which is made of four turbojets fed by kerosene and five dual-mode ramjets fed by hydrogen. The first results of a preliminary study of the concept are presented. Special attention is given to the launch and reentry trajectories, the associated heating rates, and the mass budget of the launcher. I.S.

A92-17811#

STS 2000 - A REFERENCE AIRBREATHING SSTO

ALAIN WAGNER and REGIS THEVENOT (Aerospatiale, Les

Mureaux, France) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 10 p. refs (AIAA PAPER 91-5013) Copyright

The purpose of this paper is to present the most recent results (including wind tunnel testing) dealing with a SSTO using airbreathing propulsion up to March 6. The choice of the external shape of the vehicle is explained then the aerodynamic coefficients of the glider are derived. The integration of the propulsion system (a turbo-rocket-ramjet-rocket) to the vehicle is then presented including forebody effects. The launch trajectory and the way to refine it thanks to a simultaneous optimization of the mass budget, is described. The internal accommodation and the structural concepts are briefly presented. Author

A92-33195#

DESIGN OF PENETRATION-ORIENTED MARV

S. CHAVY and T. ABENSUR (Aerospatiale, Division des Systemes Strategiques et Spatiaux, Les Mureaux, France) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 6 p. refs (AIAA PAPER 92-1003) Copyright

A multidisciplinary approach for the design of penetration-oriented maneuvering atmospheric reentry vehicles (MARV) is presented. A number of MARV concepts are investigated including various aerodynamic shapes and coefficients, masses, and control surface characteristics. Given defense and attack strategies, a kill probability matrix is computed, min-max figures are sought, and pure strategies or mixed strategies are determined. The technique enables acquisition of maximum information concerning various concepts under study, early in the project and without numerous loops between different concerned disciplines. R.E.P.

A92-55537

OPEN AND CLOSED LOOP GUIDANCE FOR AN AIRBREATHING WINGED LAUNCH VEHICLE

F. RICHARD and B. CHRISTOPHE (ONERA, Chatillon, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 16 p. Research supported by CNES. refs (IAF PAPER 92-0042; ONERA, TP NO. 1992-109) Copyright

Open and closed loop guidance for a two-stages-to-orbit air-breathing launch vehicle is discussed. From the 3D vector of acceleration derivatives, the attack and bank angle derivatives as well as the engine throttle derivative are computed. If the engine throttle control is brought to its upper bound, the attack and bank angle derivatives are computed using the projections of this vector along the ground speed axis and its orthogonal horizontal axis in order to control velocity and azimuth. The guidance law is tested in the presence of wind, aerodynamic, and propulsive model errors. A Monte Carlo simulation is performed, where dynamic model discrepancies in regard to the reference are introduced. Mean values and standard deviations of consumption and transition conditions are computed. The results demonstrated the good capacity of this guidance law to counter perturbations and model errors while preserving a good level of performance, which is particularly important in the case of a recoverable vehicle. P.D.

A92-57258

THE GERMAN HYPERSONICS TECHNOLOGY PROGRAMME - STATUS REPORT 1992

HERIBERT KUCZERA and HELMUTH HAUCK (Deutsche Aerospace AG, Munich, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 13 p. Research supported by BMFT. refs (IAF PAPER 92-0867) Copyright

A review is presented of the current Phase I of the German Hypersonics Technology Programme that continues until the end of 1992. Attention is given to the overall hypersonics technology program, the status of the Saenger reference concept, alternatives for a flight test vehicle, and the status of technological activities in the area of airbreathing propulsion. Consideration is given to aerothermodynamics and propulsion integration, materials and structures, and general program aspects. R.E.P.

A92-57262

A RESEARCH AND TECHNOLOGY PROGRAM FOR THE BENEFIT OF THE ARIANE FAMILY

J. C. CRETENET (CNES, Evry, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 5 p.

(IAF PAPER 92-0873) Copyright

An R&D program to ensure a durable foundation for the development and industrialization of Ariane family launchers is discussed. Launch system research on propulsion control, improvement of production processes, developing new materials, and acquiring a test bench is reviewed. C.D.

N92-23750# European Space Agency, Paris (France).

LAUNCHER PROPULSION TOWARDS THE YEAR 2010

VALERIE DAVID, ed. Dec. 1991 185 p In ENGLISH and FRENCH Conference held in Bordeaux, France, 11-12 Jun. 1991

(ESA-SP-327; ISBN-92-9092-150-1; ETN-92-91381) Copyright Avail: CASI HC A09/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

Conference papers covering the following sessions are presented: review of propulsion techniques used by the major space programs; technical status; and prospective developments. Several papers cover the Ariane 5 and Vulcain engine development. The Space Shuttle (U.S.) and other NASA and USSR launchers are covered. Other topics include health monitoring, reusable launch vehicles, materials for liquid propellant engines, nonpollutant solid propellants, and the future of hybrid rocket propulsion. ESA

N92-23797# Centre National d'Etudes Spatiales, Toulouse (France).

DYNAMIC LOAD CASES ON ARIANE 5

B. CHEMOUL and E. LOUAAS In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 117-122 Oct. 1991 Copyright Avail: CASI HC A02/MF A04

Ariane 5 will be able to launch payloads weighing up to 20 tons. The environmental requirements for these various payloads must be given early in the launcher's development's program. The first launcher's instrumented tests have not yet begun and for this reason some load cases still remain unknown (e.g. engines thrust decay). To find those load cases, assumptions must be made using the experience of previous programs. If this experience does not exist and if the expected load cases are supposed to be critical, particular studies must be carried out (e.g. blast wave). The low frequency load cases considered on Ariane 5 to establish the environmental requirements depend on the flight phases: lift off (blastwave, symmetrical and unsymmetrical ignition); aerodynamic flight (transonic or max dynamic pressure) gust; and end of stage's thrust (strap on boosters, Vulcain, upperstage). Several causes are presented and analyzed. Applications with Astral are shown considering the dynamical coupling between Ariane 5 and standard payloads. ESA

N92-27013# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

WINGED LAUNCHER THERMAL DESIGN ASPECTS

K. KELLER In its 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1051-1056 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The need for significant reduction in launch cost favors the consideration of reusable space transportation systems which are assisted by aerodynamic lift. The thermomechanical and thermochemical environments and the basic design requirements of two airbreathing vehicle classes are put in relation to vehicles like Shuttle and Hermes. Similarities as well as essential differences between the various vehicles are highlighted. State of the art thermal protection concepts and materials are analyzed with respect to winged launcher concepts. Future development trends

15 LAUNCH VEHICLES AND SPACE VEHICLES

for design and materials with potential application are identified. The need for improved thermostructural analysis and optimization techniques is outlined. ESA

N92-27902# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Wessling (Germany). Inst. for Flight Systems Dynamics.

OPTIMAL GUIDANCE ANTICIPATING MISSILE PERFORMANCE

W. GRIMM and K. H. WELL /in AGARD, Air Vehicle Mission Control and Management 13 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

Two different guidance methods are designed for the pre-launch phase in a one-versus-one air combat situation with missiles. In both guidance schemes a missile/target simulation is performed to estimate the miss distance at the end of a fictitious missile launch. A way to do this in real time is described. The first guidance method continuously evaluates the miss distance for each aircraft against the respective opponent. The guidance is such that the ratio of the rates of the miss distances takes an optimal value from the view of the guided aircraft. Thus, it reaches a firing opportunity first. The purpose of the second guidance method is to reach a firing position against a nonmaneuvering target in minimum time. Inside the guidance algorithm, the optimal pre-launch trajectory is approximated by nonlinear programming. It serves as a reference trajectory for the guidance. In simulations the influence of different missile and target strategies in the post-launch phase is examined. The comparison with an optimal trajectory shows the near-optimal character of the guidance method. Author

16

SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

A92-24357#

THE HERMES SEARCH AND RESCUE OPERATIONS IN THE OPEN SEA

D. BERTHELOT and P. LETALLE (Matra Marconi Space France, Velizy-Villacoublay) IN: AIAA/SOLE Space Logistics Symposium, 4th, Cocoa Beach, FL, Nov. 4-6, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 278-287.
(AIAA PAPER 91-4099) Copyright

Safeguard operations during the launch of Hermes are discussed. Emphasis is given to sea rescue and recovery. The optimal means of rescue and the basic constraints on rescue are described, and two rescue scenarios for crew recovery are examined. C.D.

A92-43596

SPECTACULAR RETURN FOR COLUMBIA - OLDEST SHUTTLE TO MAKE 13-DAY SCIENCE MISSION

Spaceflight (ISSN 0038-6340), vol. 34, no. 6, June 1992, p. 196-199.
Copyright

The Columbia 13-day-long science mission scheduled for launch on June 17, 1992 carrying the first United States Microgravity Laboratory (USML-1) is described in detail, with special attention given to the seven-member crew of the mission, the USML-1 layout design, and the scientific program to be carried out. The Extended Duration Orbital Medical Program to be carried out on board USML-1 consists of three major components: the Lower Body Negative Pressure experiment, the Variation of Heart Rate and Blood Pressure experiment, and the Microbial Air Sampler experiment. Experimental facilities for performing these experiments are described. I.S.

A92-55748

ADVANCED CARBON/CARBON PLANETARY ENTRY DECELERATOR DEVELOPMENT AND HARDWARE VERIFICATION

D. DESNOYER, C. BUCK (SEP, Suresnes, France), and M. EIDEN (ESTEC, Noordwijk, Netherlands) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p.
(IAF PAPER 92-0327) Copyright

The feasibility of a carbon/carbon decelerator for the ESA's planetary-entry probe HUYGENS which will land on Titan was tested using a representative carbon/carbon panel of conic shape manufactured and controlled by nondestructive inspection techniques. The panel was submitted to loads representative of the launch environmental dynamics and acoustic and mechanical loads. The test results were compared to the results of an analysis. Some discrepancies were found, indicating that more information on the panel behavior is needed to determine adequate safety margins. I.S.

A92-57266

ON THE RECOVERY OF THE GIANT FUEL TANKS OF SPACECRAFTS

G. SAVU and C. OPRISIU (Institute of Fluid Mechanics and Flight Dynamics, Bucharest, Romania) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs
(IAF PAPER 92-0878) Copyright

An aerodynamic method is proposed for the recovery of the giant fuel tank of a spacecraft such as the Space Shuttle, by deploying a pair of solid thin wings, which in the active phase of the launch are folded around the reservoir's circumference. During the descending phase of the trajectory, these surfaces assure sufficient lifting force to bring back and land undamaged the empty tank. The system is a compromise between the actual Space Shuttle and the future Saenger concept: the shuttle-tank complex takes off vertically, and the main tank is recovered aerodynamically, like a glider. Author

A92-57370

SAFETY AND MISSION CAPABILITIES OF MANNED LAUNCH VEHICLES

H. UTZ, A. HORNIK (Muenchen, Technische Universitaet, Munich, Germany), H. SAX, and K. LOETZGERICH (DLR, Cologne, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 12 p. refs
(IAF PAPER 92-0383) Copyright

The safety of vertical launched manned spacecraft, including capsules and winged vehicles, is discussed using Hermes and a manned capsule suitable for Ariane 5 as examples. The relative safety gains of different rescue systems are assessed by analyzing their properties, such as mission capabilities, weight, and operational aspects. The advantages of these rescue systems are also considered from the standpoint of the safety of manned spacecraft. The evaluation also includes such operational aspects as mission abort during ascent and payload accommodation. V.L.

N92-29629# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

SAENGER: THE REFERENCE CONCEPT AND ITS TECHNOLOGICAL REQUIREMENTS - AEROTHERMODYNAMICS

E. H. HIRSCHL 26 Aug. 1991 16 p Presented at Review of the German Hypersonic and Technology Programme, Bonn, Fed. Republic of Germany, 16-17 Apr. 1991
(MBB-FE-202-S-PUB-0463-A; ETN-92-91496) Copyright Avail: CASI HC A03/MF A01

The objectives of the technology program 'aerothermodynamics and propulsion integration' are defined. An overview of the special aerothermodynamic phenomena which must be regarded in the design of the Saenger lower stage which presently stands in the center of the technology program is given. The design tools, which must be provided; the components like the inlet, the afterbody, etc., which must be designed and tested; and the special problems

like forebody optimization, heat load determination, upper stage integration, etc., which must be treated, are discussed. The general work plan is presented, showing the major activities up to start of the development of the Saenger space transportation system. It includes the development and manufacturing of the experimental vehicle (HYTEXT) as a means for the validation of the design tools and methods which are achieved in the technology program, and for the creation of a freeflight data base. ESA

N92-29680# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

AEROTHERMODYNAMIC CHALLENGES OF THE SAENGER SPACE-TRANSPORTATION SYSTEM

E. H. HIRSCHL 2 Sep. 1991 13 p Presented at 1st European Symposium on Aerothermodynamics for Space Vehicles, Noordwijk, Netherlands, 28-30 May 1991 (MBB-FE-202-S-PUB-0462-A; ETN-92-91495) Copyright Avail: CASI HC A03/MF A01

The two-stage-to-orbit Saenger space transportation system is the reference concept of the German hypersonics technology program. The technology development concentrates first on the needs of the lower stage. Its requirements on aerothermodynamics and propulsion integration are sketched. The aerothermodynamic design challenge is discussed and the design tools and the design methodology are reviewed. The calibration of both the computational and the experimental methods, as well as the test of vehicle components like the inlet, control surfaces etc., make the Hypersonic Technology Experimental vehicle (HYTEX) mandatory. Contents and workplan of the technology program 'aerothermodynamics and propulsion integration' are laid out. Selected results from the current work are presented. ESA

17

SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

A92-12473 VISUAL NATURAL FEATURE TRACKING FOR AUTONOMOUS SPACECRAFT GUIDANCE BY SYMBOLIC PREPROCESSING AND ASSOCIATIVE MEMORIES

W. POELZLEITNER, G. PAAR, and G. SCHWINGSHAKL (Joanneum Research, Graz, Austria) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-059) Copyright

The current status of development to design an autonomous vision system for spacecraft guidance in special scenarios is described. Algorithms developed are especially promising in a novel approach to detect potential landmark areas to guide a spacecraft in the descent and landing phases. The overall structure of the system was designed, and special break points for crucial parts have been determined in simulation. R.E.P.

A92-18519 ITALSAT SPACECRAFT MULTIBEAM PAYLOAD ANTENNA CLOSED LOOP FINE POINTING SYSTEM

CLAUDIO CATALLO (Alenia Spazio S.p.A., Rome, Italy) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs (IAF PAPER 91-509) Copyright

The paper will describe a fine multibeam antenna pointing system for the Italian domestic communication satellite that has been successfully launched from KSC on 15 January 1991. The Antenna Pointing System (APS) has the scope to guarantee a high pointing accuracy of the communication beams to ensure the performances of the SS-TDMA Multibeam Regenerative

Payload. The APS is based on a lobe switching RF sensor, a coherent tracking receiver, a microprocessor-based controller, a motor drive electronics, and a linear actuators-employing antenna pointing mechanism. The APS provides repointing capability, automatic acquisition and tracking functions, automatic detection of the failures with ground override, and in-orbit reprogramming facilities. APS design has been verified by a combination of the analyses, computer simulations, and far-field measurements, that have demonstrated the achievement of satisfactory performances, largely within the required specification. Furthermore, preliminary in-orbit test results have shown pointing accuracy better than expected. Author

A92-21288 ERROR ANALYSIS OF THE COSPAS SARSAT SYSTEM

RYSZARD BOBER, JERZY HRECZYCHO, and IGOR JAGNISZCZAK (Maritime Academy, Szczecin, Poland) Artificial Satellites - Planetary Geodesy (no. 15) (ISSN 0208-841X), vol. 26, no. 1, 1991, p. 369-374. refs Copyright

An overview of the COSPAS-SARSAT international system that uses satellites to detect and locate emergency beacon signals from aircraft and ships in distress is presented. The influence of the number of satellites and their altitudes on mean time of visibility, and the effect of particular errors on the accuracy of position fixing are described. R.E.P.

A92-48478 DIFFERENTIAL GPS ALGORITHMS EVALUATION FOR NAVIGATION BETWEEN TWO LEO SPACECRAFT DURING RENDEZ-VOUS

J. S. LLORENTE-MARTINEZ (Grupo de Mecanica del Vuelo, S.A., Madrid, Spain) and RAFAEL LUCAS (ESTEC, Noordwijk, Netherlands) IN: NAECON 91; Proceedings of the IEEE National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 427-432. refs Copyright

An evaluation of the identified options in performing differential navigation between spacecraft in rendezvous operation at low-earth orbits has been performed, including evaluation of the parameters of the corresponding algorithms. Within this evaluation many options have been considered, and the optimal solution has been identified. With this optimal solution a method for differential navigation has been selected that provides very accurate results even in the range of centimeters, while requiring low physical requirements of CPU time and memory. I.E.

N92-12456# Office National d'Etudes et de Recherches Aeronautiques, Toulouse (France). GRECO Informatique. FORMAL SPECIFICATION OF SATELLITE TELEMETRY: A PRACTICAL EXPERIENCE

JEAN-MICHEL HUFFLEN and MICHEL LEMOINE In AGARD, Software for Guidance and Control 9 p Sep. 1991 Sponsored in part by IMAG/LIFIA, Grenoble, France; and ONERA-CERT/DERI, Toulouse, France Copyright Avail: CASI HC A02/MF A03

An experience is reviewed of using formal algebraic specifications, conducted with aeronautical industry collaboration. The objective is to provide a reusable specification for processing telemetry results. This family of spatial applications is described by means of generic formal specifications, from which telemetry could be formed. Reuse possibilities are supported by the framework. A general survey is given of this experience, including its story, the method followed for establishing the generic specifications which are the system's core, and reuse aspects provided. Author

N92-20249# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

HIGH ENERGY PROPULSION UNITS FOR THE YEAR 2000 [HOCHENERGIE-TRIEBWERKE FUER DAS JAHR 2000]

P.-A. KRAMER, G. MUNDING, H. BASSNER, H.-L. BESSER, G.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

SCHMIDT, A. SEIDEL, and K. SMIRRA 1991 26 p In GERMAN Presented at the Deutscher Luft- und Raumfahrt Kongress 1991 DGLR Jahrestagung, Berlin, Fed. Republic of Germany, 10-13 Sep. 1991 (ETN-92-90989) Avail: CASI HC A03/MF A01

The future tasks of space navigation propulsion units for the next two decades are discussed. Necessary loss equipment for commercial satellite launching and higher safety for manned missions are emphasized. Technical requirements and their solution statements are reported. New hypersonic and electrical propulsion units are to be developed in the future. New markets for propulsion units are not envisaged. It is shown that new concepts and technologies are to be studied about fifteen years prior to the applications in order to avoid incalculable risks and erroneous developments. ESA

18

SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

A92-11348 ORIENTATION AND CONTROL OF A FLEXIBLE SPACECRAFT - PLANAR MOTION

OMER MORGUL (Bilkent University, Ankara, Turkey) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 393, 394. Research supported by Scientific and Technical Research Council of Turkey. refs (Contract NSF ECS-85-00993) Copyright

A flexible spacecraft modeled as a rigid body which rotates in an inertial frame is considered; a light flexible beam is clamped to the rigid body at one end and free at the other end. It is assumed that the flexible spacecraft performs only planar motions. Two control problems are posed, namely, the orientation and the stabilization of the system. It is shown that suitable boundary controls applied to the free end of the beam and suitable control torques applied to the rigid body solve the problems. I.E.

A92-14714
A PREDICTION METHOD TO EVALUATE THE ACOUSTIC RESPONSE OF SPACECRAFT EXTERNAL PANELS - AN APPLICATION TO THE ITALSAT STRUCTURE DEVELOPMENT F. MORGANTI (Alenia Spazio S.p.A., Rome, Italy) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 14 p. refs (IAF PAPER 91-288) Copyright

Applications of a prediction method development during the Italsat F1 structural design phase are discussed. The method had the main purpose to finalize some structural modifications capable of reducing the random vibrations on the east and west panels of the spacecraft. Starting from an experimental data base, an analytical method, based on the structural modes superposition, has been applied to predict the response of the flight model spacecraft. The method has been validated with acoustic tests on panel specimens having different structural design and mass distribution, with the purpose of discerning the effects of the structure alone (in terms of mass and stiffness) and of the units lumped mass. Author

A92-14722
EFFECTS OF ATOMIC OXYGEN ON SPACECRAFT MATERIALS - SIMULATION AND MEASUREMENT I. L. HARRIS, T. M. WATKINSON, A. R. CHAMBERS, G. T.

ROBERTS, A. R. L. TATNALL (Southampton, University, England), and J. P. W. STARK (British Space Systems, Ltd., Stevenage, England) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. Research supported by Defence Research Agency. refs (Contract SERC-GR/F/03622; SERC/GR/F/60755) (IAF PAPER 91-305) Copyright

This paper describes the atomic oxygen environment encountered in space and the effect it has on materials used for spacecraft and instrumentation. The novel simulation facilities at Southampton University are described and the material effects observed are discussed. At Southampton a 3kW arcjet device has been used to provide a beam of atomic oxygen with energies up to 1eV and flux levels of 10×10^{15} atoms/sq cm s. This device has been used to measure the erosion of different materials and these results are comparable with those observed by other laboratory experiments and those observed on Shuttle. In order to achieve the energies and fluxes found in LEO, a new facility is being developed using magnetoplasma dynamic effects. Another related project to develop an instrument capable of remotely monitoring atomic oxygen flux and materials erosion in ground-based facilities or in orbit, is also described. Author

A92-14751 HERMES-SPACE STATION PHASING STRATEGIES OPTIMIZATION

FRANCOIS DUFOUR, JEAN M. GARCIA, JACQUES BERNUSSOU (CNRS, Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse, France), and JEROME LEGENNE (CNES, Toulouse, France) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-345) Copyright

A LEO coplanar rendezvous between a shuttle and a space station is considered. A four-maneuver phasing strategy has been optimized by a dynamic programming algorithm in the nominal case (deterministic trajectories). The model used is characterized by a gravitational perturbation, an atmospheric drag, and a crew activity schedule. It is demonstrated that the chaser is always able to complete a rendezvous mission within two days for all the range of injection phase angles. Rendezvous sequences are characterized with emphasis placed on optimal costs, maneuver dates, and drift orbit specifications. O.G.

A92-15384
A DYNAMICS PARAMETER INVARIANT ATTITUDE CONTROL SYSTEM FOR FLEXIBLE SPACECRAFT S. J. DODDS (East London, Polytechnic, Dagenham, England) and R. P. G. HEATH (Integrated Systems, Inc., Cambridge, England) IN: Dynamics of flexible structures in space; Proceedings of the 1st International Conference, Cranfield, England, May 15-18, 1990. Southampton, England/Berlin and New York, Computational Mechanics Publications/Springer-Verlag, 1990, p. 157-181. refs Copyright

A universal control system is presented which is applicable to a wide range of spacecraft with collocated sensors and continuous actuators mounted on a rigid center-body. Attitude acquisition from relatively large initial errors is performed near-time-optimally without a detailed knowledge of the spacecraft dynamics. This includes large angle slewing about all three control axes simultaneously with the aid of the quaternion attitude representation and the associated kinematic differential equations. A parameter invariant closed-loop performance is achieved for small attitude errors together with extreme stiffness with respect to disturbance torques. The control system embodies a sliding-mode control law with curved switching boundaries used in conjunction with an on-line center-body moment of inertia matrix estimator. Embodiment of active flexure mode damping using a 'posicast' approach is investigated together with the associated trade-off with center-body attitude control performance. Digital computer simulations with several spacecraft dynamics models are presented. Author

A92-15409

MODELLING AND IDENTIFICATION OF FLEXIBLE SPACECRAFT

P. PH. VAN DEN BROEK, J. A. MULDER (Delft University of Technology, Netherlands), and Q. P. CHU (Chinese Academy of Sciences, Space Science and Technology Center, Beijing, People's Republic of China) IN: Dynamics of flexible structures in space; Proceedings of the 1st International Conference, Cranfield, England, May 15-18, 1990. Southampton, England/Berlin and New York, Computational Mechanics Publications/Springer-Verlag, 1990, p. 617-627. refs

Copyright

A new approach to spacecraft parameter estimation is proposed which reduces the number of unknown parameters to a manageable level. The approach is based on the finite element method for generating a high-order dynamical model of the spacecraft. Quasi-static approximations of the low-frequency characteristic modes resulted in an order reduction of the dynamical finite element model. Stochastic model disturbances are introduced to account for model errors resulting from the structural discretization and the quasi-static approximations. The model order reduction is used to improve the numerical efficiency of a maximum likelihood prediction error estimator. O.G.

A92-15410

EIGENVALUE REALISATION METHODS FOR THE IN-ORBIT IDENTIFICATION OF LARGE FLEXIBLE SPACECRAFT STRUCTURES

J. E. COOPER and J. R. WRIGHT (Manchester, Victoria University, England) IN: Dynamics of flexible structures in space; Proceedings of the 1st International Conference, Cranfield, England, May 15-18, 1990. Southampton, England/Berlin and New York, Computational Mechanics Publications/Springer-Verlag, 1990, p. 629-643. refs

Copyright

In this paper two Multi-Input Multi-Output state space methods suitable for the in-orbit system identification of space structures are considered. The ERA (Eigensystem Realization Algorithm) method, which has already been used successfully on the Solar Array Flight Experiment, is compared to the ERA/DC (ERA using Data Correlations) method in terms of the formulation and computational effort. The methods are applied to simulated data from a space station type model. The ERA/DC method requires less model overspecification in the presence of noise than the ERA method for similar quality of results. A revision of the ERA/DC method is suggested. Author

A92-16126

THERMOMECHANICAL MODEL OF THE LINKAGE BETWEEN AN I.R. WINDOW AND THE HOUSING DEVICE

V. J. BRUN (ONERA, Division de Thermophysique, Chatillon, France) (European Conference on Electromagnetic Structures, 6th, Friedrichshafen, Federal Republic of Germany, Sept. 4-6, 1991) ONERA, TP no. 1991-158, 1991, 11 p. Research supported by DRET. refs

(ONERA, TP NO. 1991-158)

The model of Laturelle et al. (1989) for simulating the thermomechanical behavior of the IR window during supersonic flights is modified in order to describe the region of the linkage between the IR window and the housing device more realistically. Using a very accurate mesh, it was refined in the sensitive regions of the two joints between the dome and the housing device. Thermal calculations were performed taking into account radiative and convective boundary conditions. For mechanical computations, materials were used that are able to withstand large displacements and large strains. In addition, 'contact elements' were introduced which can simulate the deformation of surfaces that are initially in contact or are expected to come into contact during the response solution. It is shown that the new model of the attachment area can withstand very severe conditions. I.S.

A92-18494

THE ENHANCEMENT OF THE ITALSAT SPACECRAFT - A STEP FORWARD THE COMMUNICATION SATELLITES

G. MORELLI and A. DI CECCA (Alenia Spazio S.p.A., Rome, Italy) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs

(IAF PAPER 91-473) Copyright

This paper deals with the new generation of communication spacecraft, strictly derived from the Italsat experience and success, which is under development in Alenia Spazio. An overview of future communication missions is provided in terms of system requirements able to define the spacecraft platform enhancement. Author

A92-23433

A METHOD FOR DETERMINING THE POTENTIAL OF A SPACECRAFT [METOD ZA OPREDELIJANJE POTENCIJALA NA KOSMICHESKII OBEKT]

S. K. CHAPK'NOV, TS. P. DACHEV, I. B. IVANOV (B'lgarska Akademiia na Naukite, Institut za Kosmicheski Izsledvaniia, Sofia, Bulgaria), V. N. ORAEVSKII, and V. V. TEMNYI (IZMIRAN, Troitsk, USSR) Aerokosmicheski Izsledvaniia v B'lgaria (ISSN 0861-1432), vol. 7, 1991, p. 70-74. In Bulgarian. refs

Copyright

The existing methods for determining the potential of a spacecraft are described. Problems of the existence of the object's potential are connected with the space conditions in the presence of operating injectors on board the active vehicles, and require the development and application of specialized devices for determining potential. A method is described where the potential value is determined, as well as its time characteristics in the first few microseconds after injection. A unique analyzing voltage sine scanning generator is used instead of the conventional step generators. In this case the energy consumption is half that of conventional methods. P.D.

A92-24207

OPERATIONAL ASPECTS OF SPACECRAFT AUTONOMY

A. PIDGEON, G. HOWARD, and B. SEATON (Vega Space Systems Engineering, Ltd., Harpenden, England) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, Feb. 1992, p. 87-92. refs

Copyright

The European Space Agency (ESA) has plans for a number of challenging missions in its Horizon 2000 program. These will include several interplanetary or deep space missions, such as the ROSETTA comet nucleus sample return mission, as well as a number of near-earth scientific and technological missions. For many of these missions, there will be long periods when they are out of contact with the ground controllers, due to limited ground station coverage or lack of availability of the NASA Deep Space Network. The operational requirements for these missions lead to a technological solution based on spacecraft autonomy. This enables the spacecraft to perform its own onboard management, fault diagnoses, and recovery actions while out of ground contact. This paper investigates the operational requirements which drive spacecraft autonomy and the impact it will have on the conduct of the spacecraft operations during the mission. Author

A92-27130

SPACE ENVIRONMENT: PREVENTION OF RISKS RELATED TO SPACECRAFT CHARGING; INTERNATIONAL COURSE ON SPACE TECHNOLOGY, TOULOUSE, FRANCE, NOV. 26-30, 1990, PROCEEDINGS [ENVIRONNEMENT SPATIAL: PREVENTION DES RISQUES LIES AUX PHENOMENES DE CHARGE; COURS INTERNATIONAL DE TECHNOLOGIE SPATIALE, TOULOUSE, FRANCE, NOV. 26-30, 1990, PROCEEDINGS]

Course sponsored by CNES. Toulouse, France, Cepadues-Editions, 1992, 487 p. In French and English. For individual items see A92-27131 to A92-27146.

(ISBN 2-85428-288-4) Copyright

The present volume discusses topics concerning the earth's magnetosphere and ionosphere, space environment modeling, ion effects on integrated circuits, orbital anomalies due to electrostatic discharges, analytical and computer modeling of spacecraft

potentials, and the electrical properties of materials. Also discussed are electrostatic charging by high-energy electrons, surface discharges on electron-irradiated polymers, the environmental interactions of solar cell arrays in LEO, and numerical simulations of the electromagnetic environment. O.C.

A92-28133

SPACECRAFT IN-ORBIT IDENTIFICATION USING EIGENSYSTEM REALIZATION METHODS

J. E. COOPER and J. R. WRIGHT (Manchester, Victoria University, England) (Dynamics of flexible structures in space; Proceedings of the 1st International Conference, Cranfield, England, May 15-18, 1990, p. 629-643) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, Mar.-Apr. 1992, p. 352-359. Previously cited in issue 04, p. 527, Accession no. A92-15410. refs Copyright

A92-29704

ANALYSIS OF A REDUNDANT FREE-FLYING SPACECRAFT/MANIPULATOR SYSTEM

DRAGOMIR NENCHEV (Sofia, Technical University, Bulgaria), YOJI UMETANI, and KAZUYA YOSHIDA (Tokyo Institute of Technology, Japan) IEEE Transactions on Robotics and Automation (ISSN 1042-296X), vol. 8, Feb. 1992, p. 1-6. refs Copyright

An analysis of the momentum conservation equations of a redundant free-flying spacecraft/manipulator system acting in a zero-gravity environment is presented. In order to follow a predefined end-effector path, the inverse kinematics at velocity level is considered. The redundancy is solved alternatively in terms of pseudoinverses and null-space components of the manipulator inertia matrix, the manipulator Jacobian matrix, and the generalized Jacobian matrix. A general manipulation task is defined as end-effector continuous path tracking with simultaneous attitude control of the spacecraft. Three subtasks of the general task are considered. The case of manipulator motions that yield no spacecraft attitude disturbance is analyzed in more detail and a special 'fixed-attitude-restricted' (FAR) Jacobian is defined. Through singular-value decomposition of this Jacobian, corresponding FAR dexterity measures (FAR manipulability and FAR condition number) are derived. I.E.

A92-33410

SPACECRAFT STRUCTURES

RAYMOND F. TURNER (Rutherford Appleton Laboratory, Didcot, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 195-228. refs Copyright

Consideration is given to spacecraft structural design, including not only materials selection and configuration but also analysis and verification testing as part of the design process. A number of formal design reviews are specified in order to assess the interaction of all the separate design factors and subsystems. A generalized list of requirements for structures is given: accommodation for the payload and spacecraft systems, capability to withstand launch loads, stiffness, environmental protection, alignment, thermal and electrical paths, and accessibility. Criteria for the selection of materials include the following: specific strength, stiffness, stress corrosion resistance, thermal parameters, sublimation/erosion, and ease of manufacture/modification. Design for launch, configuration examples, design verification, and the future of space structures are discussed. P.D.

A92-33413

THERMAL CONTROL OF SPACECRAFT

ROSS HENDERSON (Southampton, University, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 275-302. refs Copyright

Thermal control of spacecraft as a requirement for maintaining structural and equipment integrity over long periods of time is addressed. Attention is given to the space environment's high vacuum, or the virtual absence of atmospheric pressure. The

aerodynamic heat flux associated with earth satellites is indicated; it is shown that at 150 km it is approximately equal to the solar constant (at earth orbit). From 150 to 300 km it reduces by two orders of magnitude. The solar radiation parameters of concern in thermal design are spectral distribution, intensity, and degree of collimation. Internal heat sources represented by the equipment operated inside the spacecraft body and dissipating energy as heat are discussed. The absorptance/emittance ratio for a selection of surfaces and finishes are given. Thermal models of spacecraft, necessary for the complex configurations of most designs, are examined. P.D.

A92-33417

SPACECRAFT ELECTROMAGNETIC COMPATIBILITY ENGINEERING

LES J. C. WOOLLISCROFT (Sheffield, University, England) IN: Spacecraft systems engineering. Chichester, England and New York, John Wiley and Sons, 1991, p. 385-391. refs Copyright

EMC engineering, which is concerned with ensuring that the complex electronic systems of a spacecraft neither suffer nor cause EMI in orbit or during the test and launch phases of a program, is examined. Attention is given to interference paths, conducted, 'radiated', and plasma-coupled interference, and dc magnetic and electric fields. Practical techniques used to achieve EMC, as well as the establishment of an EMC control program are discussed. P.D.

A92-40547

NATURAL FREQUENCIES OF A ROTATING CABLE/SPACECRAFT SYSTEM

J. M. SHIPPEN (Birmingham, University, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 103-113. refs Copyright

Dynamic analyses are presented of a spin-stabilized spacecraft that can be regarded as a rigid central body with several deployed cables. Firstly, the normal modes analysis is carried out of an isolated cable attached to a rigid body spinning at a constant angular velocity. This initial decomposition is reasonable as light cables attached to a massive central body behave independently as a first approximation and simplifies the derivation of the equations of motion. The three-dimensional wave equation in a rotating coordinate system is derived and solutions found using a lumped parameter approach. This analysis is novel as it presents an analysis technique to study the effect on the natural frequencies of physical characteristics (that is vibration planes containing and normal to the spin axis) and varying design parameters (that is cable length, cable density, tip mass) are considered. The study is then extended to consider the interaction of the cables and the central body for a system that is not subjected to external torques. Author

A92-49046#

ADVANCED SPACECRAFT CONCEPTS USING ELECTRICAL PROPULSION

M. PERDU (Aerospatiale, Division Systemes Strategiques et Spatiaux, Cannes-la-Bocca, France) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992, 12 p. refs (AIAA PAPER 92-3513) Copyright

Advanced spacecraft concepts which are based on electrical propulsion units, inclusive dedicated power, and propellant supply equipment are proposed. These concepts are compatible with the Spacebus New Generation Platform which is being developed under Aerospatiale program. Particular attention is given to the optimization of the attitude control concept for the geostationary phase of the spacecraft power management system. O.G.

A92-55527

A QUASI ADAPTIVE MAGNETIC DAMPING STRATEGY FOR GRAVITY GRADIENT STABILIZED SPACECRAFT

C. ARDUINI, P. BAIOTTO, D. MORTARI, and M. PARISSE (Roma I, Università, Rome, Italy) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 13 p. refs (IAF PAPER 92-0031) Copyright

The stability of the general formulation of a magnetic auxiliary control strategy is examined for a gravity-gradient-stabilized spacecraft evidencing that there is a large number of possible solutions. One particular strategy is explicitly formulated based on a reference model ideal behavior of the system. This strategy is then compared, by means of nonlinear simulations to a typical algorithm. The results show that the proposed strategy can produce better performance for the same power consumption. Author

A92-57214

CARINA - A SPACE VEHICLE WITH RE-ENTRY CAPABILITIES FOR MICROGRAVITY EXPERIMENTS

G. BORRIELLO, A. SANSONE (Alenia Spazio S.p.A., Naples, Italy), and A. RICCIARDI (ASI, Rome, Italy) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. (IAF PAPER 92-0816) Copyright

An Italian autonomous space vehicle with recovery capabilities, named CARINA (Capsula di Rientro Non Abitata), is described with special attention given to the technological developments in areas pertaining to the reentry system, including reentry aerothermodynamics and the design of the thermal protection system. Consideration is also given to the configuration of the CARINA vehicle (comprised of the expendable Service Module and the Apollo-like Reentry Module), the subsystems and their performances, the mission life cycle, the microgravity utilization aspects, and the programmatic aspects. I.S.

A92-57328

SPACECRAFT LOW FREQUENCY RESIDUAL ACCELERATION

HANS HAMACHER (DLR, Cologne, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs (IAF PAPER 92-0970) Copyright

An analytical model is described to calculate the low frequency acceleration of Spacelab missions. The three principal low-frequency perturbations of the Space Shuttle Orbiter are taken into account: atmospheric drag, gravity gradient (tidal effect), and spacecraft rotation. These effects are modeled on the basis of rigid-body dynamics which implies a sufficient margin to the systems fundamental frequency. The calculation of atmospheric drag is based on a dynamic model of the atmosphere which takes into account the diurnal density variation. Gravity gradient and rotational accelerations are calculated from the spacecraft attitude data. The main characteristics of the low-frequency accelerations are discussed on the basis of predicted data for the Spacelab mission D-2. Author

N92-11069 Aston Univ., Birmingham (England).

DRAG COEFFICIENTS WITH APPLICATIONS TO SATELLITE ORBITS Ph.D. Thesis

ANDREW SOWTER 1989 134 p
Avail: Univ. Microfilms Order No. BRDX92778

In the last twenty or so years, the results of theory and experiment have produced much information on the characteristics of gas-surface interactions relevant to a satellite in hyperthermal free-molecular flow. Reviews of the rarefied gas dynamics that are applicable to satellites are presented, and an attempt to compare existing models of gas-surface interaction with contemporary knowledge of such systems is made. It is shown that a more natural approach would be to characterize the gas-surface interaction using the normal and tangential momentum accommodation coefficients (σ_n and σ_t , respectively) specifically in the form $\sigma = \text{constant}$, $\sigma' = \sigma \sin^2 \theta$ (sub 0) - $\sigma \sin^2 \theta$ (sub 1) sec θ (sub 1) where θ (sub 1) is the angle subtended between the incident flow and the surface normal and σ , σ' (sub 0) and σ' (sub 1) are constants. Adopting these relationships, the effects of atmospheric lift on inclination and the effects of atmospheric drag on the semi-major axis and eccentricity

were investigated. Applications to ANS-1 (1974-70A) show that the observed perturbations in inclination can be ascribed primarily to nonzero σ' (sub 1) while perturbations in the semi-major axis and eccentricity produce constraint equations between the three parameters. The numerical results seem to imply that a good theoretical orbit is achieved despite a much lower drag coefficient than anticipated by earlier theories. Dissert. Abstr.

N92-14977# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

ANALYSIS TOOLS OF ONERA AND DLR FOR THE AEROTHERMODYNAMICS OF REENTRY VEHICLES

P. BARRILLOT (Institut de Mécanique des Fluides de Lille (France).), J. M. BOUSQUET (Institut de Mécanique des Fluides de Lille (France).), G. BRENNER (Deutsche Keramische Gesellschaft, Bad Honnef (Germany, F.R.)), J. L. DACOSTA (Institut de Mécanique des Fluides de Lille (France).), D. DEVEZEAUX (Institut de Mécanique des Fluides de Lille (France).), P. NIEDERDRENK (Deutsche Keramische Gesellschaft, Bad Honnef (Germany, F.R.)), R. RADESPIEL (Deutsche Keramische Gesellschaft, Bad Honnef (Germany, F.R.)), P. SAGNIER (Institut de Mécanique des Fluides de Lille (France).), and J. SCHOENE (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) /n ESA, Aerothermodynamics for Space Vehicles p 39-46 Jul. 1991 Previously announced in IAA as A91-53246 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Design analysis of space planes must include all flow phenomena occurring during the reentry phase of the flight. Aerodynamic and aerothermic tools must be able to treat hypersonic, supersonic and subsonic flow fields. In the frame of Hermes Technical Assistance (TA) for the National Center for Space Studies (CCNES), DLR and ONERA have improved their numerical tools in order to increase their capabilities. Euler codes are necessary to compute aerodynamic coefficients during the hyper/supersonic part of the flight. The Panel Method is used for subsonic flow. For aerothermal load calculations, engineering methods allow short term response. More sophisticated methods, such as coupled Euler/boundary layer solvers, are used to study critical design points, including nonequilibrium and wall catalytic phenomena. Navier-Stokes solvers are used to study separation phenomena. Examples of application are presented. They show the present capability of TA teams to perform aerothermodynamic evaluations for Hermes design. ESA

N92-14980# Alenia Spazio S.p.A., Naples (Italy).

AEROTHERMODYNAMIC DEVELOPMENT OF THE CARINA RE-ENTRY VEHICLE: CFD ANALYSES AND EXPERIMENTAL TESTS

A. MARZANO, M. SOLAZZO, A. SANSONE, A. CAPUANO, and G. BORRIELLO /n ESA, Aerothermodynamics for Space Vehicles p 67-72 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The CARINA (Italian acronym for unmanned reentry capsule) system is a microgravity payload carrier with reentry capability. In the frame of the design activities for the CARINA system, the aerothermodynamic characterization of the reentry vehicle is one of the most considerable efforts. Furthermore, the design aspects of such a vehicle are largely unexplored in Europe, requiring a technological program to support the development of the knowledge in this research area. After a tradeoff analysis and preliminary studies, a more in depth approach to the problem was planned. Two different driving lines are pointed out: the utilization of Computational Fluid Dynamics (CFD) tools and the contemporary development of an adequate experimental campaign. Test results, compared with the numerical predictions, are illustrated. ESA

N92-23780# European Space Agency, Paris (France).

SPACECRAFT STRUCTURES AND MECHANICAL TESTING, VOLUME 1

W. R. BURKE, comp. (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

) Oct. 1991 487 p In ENGLISH and FRENCH Conference held in Noordwijk, Netherlands, 24-26 Apr. 1991; sponsored by ESA, CNES, and DLR (ISSN 0379-6566) (ESA-SP-321-VOL-1; ISBN-92-9092-126-9; ETN-92-91208) Copyright Avail: CASI HC A21/MF A04

Papers presented at the conference were directly associated with space project applications of scientific, Earth observation and telecommunication satellites, reporting hardware design, development and testing and other related experiences. Volume 1 presents sessions on the following: space plane and reentry; vibroacoustics; testing (systems); multibody dynamics (microgravity); launcher (development and loads/optimization); space stations; dynamic identification; analysis (methods, dynamics, fluid/structure interaction); and materials (composites, characterization, fracture/fatigue). The most important points identified are the need for a better understanding of launcher loads, qualification requirements imposed by launcher authorities to cover launch events, and particular qualification requirements imposed by space projects and programs to ensure mission success.

ESA

N92-23786# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).

PROTECTION OF SPACECRAFT AGAINST METEOROID/ORBITAL DEBRIS IMPACTS

HANS-G. REIMERDES In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 43-49 Oct. 1991 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.

Copyright Avail: CASI HC A02/MF A04

As a result of the space activities during the last three decades there are lots of artificial particles orbiting the Earth, the so called orbital debris. These particles increase the probability that spacecraft will be hidden during mission considerably. Especially large spacecraft planned for long missions will be endangered and have to be protected against this new threat. Techniques for protection of spacecraft are presented and compared. Semi-empirical formulae for calculation of dimensions of protection systems are given. Based on these formulae and on the direction distribution of the particles, three different approaches for reduction of the required mass of the protection system are presented.

ESA

N92-23821# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France).

LARGE THIN COMPOSITE THERMOSTRUCTURAL PARTS

D. DESNOYER, A. LACOMBE, and J. M. ROUGES In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 283-291 Oct. 1991

Copyright Avail: CASI HC A02/MF A04

The new space transportation projects (Sanger, Hotol, STAR-H, STS 2000, NASP, and Hermes) have a challenge with their system mass performance. Due to the overall size of these systems, large surface high temperature parts are mandatory in order to increase the system reliability in decreasing the junction number (seals and fasteners) and to decrease the overall mass. To be mass efficient, these large parts should be thin. The rigidity is provided by integrated stiffeners. Depending on the reentry atmosphere, two main types of environment constraints should be considered: an oxidizing and nonoxidizing environment. For the oxidizing environment, an SiC matrix was selected and large parts were manufactured demonstrating the availability and validity of the technologies. Material tests performed under plasma arc jet showed the oxidizing resistance of the material. For the nonoxidizing environment (i.e. planetary reentry) carbon-carbon can be selected. A conic shaped panel with integrated stiffeners was studied and manufactured. The skin thickness is 0.5 mm with no delaminable preform.

ESA

N92-23825# MATRA Espace, Toulouse (France).

INFLUENCE OF MICROVIBRATIONS ON SPACECRAFT PERFORMANCES

N. JOURDON and V. GUILLAUD In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 317-322 Oct. 1991 Copyright Avail: CASI HC A02/MF A04

Along with technology advances in the field of optical and laser payload, spacecraft pointing accuracy requirements become more and more severe, especially for scientific and Earth observation satellites. Attitude and orbit control equipments and payload moving parts generate in-orbit microvibrations which are critical to instruments line of sight pointing performance. A number of activities aimed at characterizing the in-orbit microvibrations endured by spacecraft payloads such as SPOT 4, SILEX, and SOHO were undertaken. A ground test campaign performed on SPOT flight model 3 is focused on. Primary objectives were to measure the structural damping coefficient. The test led to the conclusion that damping coefficients of 0.5 can be anticipated in orbit. It also demonstrated a relatively good representativeness of finite element models used for performance predictions.

ESA

N92-23836# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

STRETCHED SKIN CONCEPT FOR THE ENTRY AERODYNAMIC DECELERATOR SYSTEM OF PLANETARY PROBES

C. BONNET, J. F. PUECH, and M. RIGAUT In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 393-397 Oct. 1991

Copyright Avail: CASI HC A01/MF A04

The joint NASA/ESA Cassini/Huygens mission is one of the forthcoming planetary exploration missions making use of a high drag decelerator. The requirements of this mission were used to support studies on new concepts for entry devices. Preliminary linear analysis performed on a very lightweight concept decelerator, based on ultra thin carbon-carbon skin showed that buckling is a driver during the entry phase. To avoid the consequence in stability of these stresses in the skin, the idea of using only a carbon fiber fabric without carbon impregnation was suggested. This was the first step towards the stretched skin concept. The second step was to design a proper structure to stretch the fabric. This concept, composed of a high temperature annular fabric, stretched into a rigid medium temperature armature and connected to the cold descent module structure, is described. A performance analysis is globally performed, and the predicted mass of the stretched skin concept is competitive. The technical feasibility is outlined.

ESA

N92-23967# European Space Agency, Paris (France). Publications Div.

THE REENTRY OF SALYUT-7/KOSMOS-1686

B. BATTRICK, ed. Aug. 1991 99 p International workshop held in Darmstadt, Fed. Republic of Germany, 9 Apr. 1991 (ISSN 0379-6566)

(ESA-SP-345; ISBN-92-9092-222-2; ETN-92-91187) Copyright Avail: CASI HC A05/MF A02

The proceedings of an international workshop on the reentry of Salyut 7/Kosmos 1686, held two months after the event, are presented. An account of what happened is given, and the technical problems and difficulties are described. A general discussion of the accidental reentry of risk objects is included. The question of how the various facets of reentry predictions can be improved was of great importance.

ESA

N92-23974# Hyperschall-Technologie-Gesellschaft, Lindau Harz (Germany).

MODELLING OF AERODYNAMIC FORCES AND HEAT TRANSFER FOR ORBITAL DECAY AND REENTRY CALCULATIONS

G. KOPPENWALLNER and D. JOHANNISMEIER In ESA, The Reentry of Salyut-7/Kosmos-1686 p 57-62 Aug. 1991

Copyright Avail: CASI HC A02/MF A02

In order to improve orbital decay and reentry calculations of satellites, an appropriate aerodynamic model is necessary. The aerodynamic data along the trajectory can be provided either in numerical tables generated by large computer codes or by analytical formulas. The latter method requires a simplified description of the vehicle shape and aerodynamic flow models for free molecular flow, rarefied flow, and hypersonic continuum flow. ESA

N92-24387# Technische Hochschule, Aachen (Germany). Inst. fuer Leichtbau.

DETERMINATION OF THE STRUCTURAL WEIGHT OF SPACECRAFT [ERMITTLUNG DES STRUKTURGEWICHES VON RAUMFLUGZEUGEN]

J. ALBUS /In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 93-94 Dec. 1990 In GERMAN

Avail: CASI HC A01/MF A02

Models are being developed for a reliable estimation of the structural weight of spacecrafts, based on a preliminary design, with a view to an optimization of the configuration. Calculation methods are based on transfer matrices. Several stability analysis methods can be used, taking into account imperfections and plasticity. Interaction equations provide the stability limits in case of combined loads. A programming system for the design of axisymmetric cryogenic fuel tanks was developed. Analytical-empirical mass analysis methods as well as methods for the determination of maneuver, gust, and landing loads are being developed. ESA

N92-24389# Gesamthochschule, Duisburg (Germany).

MODELING AND SIMULATION OF COMPLEX MECHANICAL SYSTEMS FOR SPACE APPLICATIONS [MODELLIERUNG UND SIMULATION KOMPLEXER MECHANISCHER SYSTEME MIT ANWENDUNGEN IN DER RAUMFAHRT]

M. HILLER /In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 99 Dec. 1990 In GERMAN

Avail: CASI HC A01/MF A02

In the framework of the research program 'Dynamics of Multibody systems', methods are being developed for the modeling and simulation of complex space systems (such as satellites, large antennas, and space stations) characterized by the occurrence of kinematic loops. In particular, the interaction between large rigid body motions and small elastic deformations are taken into account. A computer program is developed and test calculations are being performed in several spacecraft systems. ESA

N92-24432# European Space Agency, Paris (France).

SPACECRAFT GUIDANCE, NAVIGATION AND CONTROL SYSTEMS

W. R. BURKE, comp. Dec. 1991 610 p The 1st international conference was held in Noordwijk, Netherlands, 4-7 Jun. 1991 (ISSN 0379-6566)

(ESA-SP-323; ISBN-92-9092-134-X; ETN-92-91380) Copyright Avail: CASI HC A99/MF A06

Papers on spacecraft Guidance, Navigation, and Control (GNC) systems are presented. Missions include the SOHO (Solar Heliospherical Observatory), Polar Platform AOCS (Attitude and Orbit Control System) Columbus, CRAF (Comet Rendezvous/Asteroid Flyby) and Cassini, Artemis and DRS (Data Relay Satellite), Rosetta, Data Relay Technology Mission (DRTM), SPOT, Polar Platform, and Cluster. Papers are divided under the following subheadings: missions; rendezvous and docking (RVD) systems; high accuracy; reentry/launchers; attitude measurement; RVD implementation; Hermes; verification; navigation; gimbal wheels; software/algorithms; FDIR (fault detection, isolation and recovery); analysis; in orbit experience. ESA

N92-24433# British Aerospace Public Ltd. Co., Bristol (England). Earth Observation and Sciences Div.

DESIGN ASPECTS OF THE ATTITUDE CONTROL SYSTEM FOR THE SOHO SPACECRAFT

T. D. WOOD and C. D. JAMES /In ESA, Spacecraft Guidance, Navigation and Control Systems p 3-8 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

The Solar Heliospherical Observatory (SOHO) spacecraft is to be placed in a halo orbit around the first Lagrangian point L1 of the Sun-Earth system. The orbit is inherently unstable and consequently requires tight control of delta-V magnitude and direction (25 arcseconds). Attitude control will allow points on the Sun to be observed with a stability of better than 0.8 arcseconds, while tracking the Sun spin axis with a (1 minute) stability of 18.9 arcseconds, in the presence of payload disturbances of 0.02 nms. The soho mission is outlined and the spacecraft and attitude system are described. The control law design adopted to meet the stringent pointing required is examined. ESA

N92-24443# Italspazio, Rome (Italy).

GPS DIFFERENTIAL NAVIGATION TECHNIQUES FOR CARINA REENTRY AND SPACECRAFT RENDEZVOUS OPERATIONS

G. BARRESI, L. CAPORICCI, and C. SODDU /In ESA, Spacecraft Guidance, Navigation and Control Systems p 79-86 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

Absolute GPS (Global Positioning System) navigation techniques are adaptable in the operational and experimental phases of most missions; GPS autonomous navigation allows the use of independent procedures to perform many onboard operations without any ground command. The dedicated ground segment can be reduced and the experimental data can be transmitted to the ground station during short period of visibility. Differential GPS operations greatly reduce the effects of selective availability, ionosphere, troposphere and other slow varying errors for users both in a local area around a reference station and between two users performing their relative navigation by differencing their absolute measurements. This technique can profitably be used during specific periods such as reentry phase or rendezvous operations due to the enhanced performances achievable. The results of studies on the usability of the GPS for the relative navigation between two space vehicles and on trajectory determination of a reentry vehicle are presented. ESA

N92-24445# MATRA Espace, Paris-Velizy (France). Automatic Studies.

THE ATTITUDE AND ORBIT CONTROL SYSTEM ON THE ARISTOTELES SATELLITE

P. PEYROT /In ESA, Spacecraft Guidance, Navigation and Control Systems p 97-101 Dec. 1991

Copyright Avail: CASI HC A01/MF A06

The feasibility studies and the preliminary design of the attitude and orbit control and propulsion subsystems (AOCS/RCS (Rate Control System)) for the Aristoteles satellite, as defined in phase A studies, are summarized. The main design drivers for the AOCS are the acceleration stability requirement (10(exp -7) rd/sq s, 5 x 10(exp -7) rd/sq s in the range of 0.005 to 0.125 Hz), and the magnetometer attitude determination accuracy (20 arcseconds); operating on a very low altitude orbit (200 Km) is an additional constraint. The proposed AOCS concept allows the autonomy required by orbit altitude. Fine attitude control is achieved using low noise gyros and low disturbance reaction wheels with PID controller. Star sensors provide measurements for the fine attitude estimation. The capability of drag control is specific to Aristoteles; it is achievable by control of the cross section area with deployable flaps. An attitude yaw steering mode is possible to minimize the disturbances from lateral aerodynamics forces. The RCS design drivers are the total impulse requirement to achieve the various orbit corrections and maintenance, and the fuel management requirement to limit dynamic disturbance and motions of the center of mass. The selected hydrazine RCS has a storage capacity about 1000 kg; the tanks have elastomeric membrane to limit fuel motions. A continuous estimation of individual tank consumption

is achieved which allows the balancing of the fuel mass in the various tanks. An assessment of the performances of the AOCS/RCS is shown to validate the concepts. ESA

N92-24451# MATRA Espace, Toulouse (France). TRAJECTORY OPTIMISATION AND GUIDANCE STRATEGIES FOR REENTRY

S. JALLADE, T. DUHAMEL, and C. CHAMPETIER / In ESA, Spacecraft Guidance, Navigation and Control Systems p 137-144 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

The emergence in Europe of missions involving reentry for atmospheric transfer trajectories has spawned the need for general purpose software to optimize these trajectories. The envisaged software must be able to accept a wide variety of models, optimization criteria and constraints. A study in which the dynamics, atmosphere, aerodynamics and heat flux models were selected to be implemented in the software as well as a number of cost functions and constraints is presented. The available numerical techniques to solve the associated control problems are surveyed and a direct collocation method is selected because of its versatility and robustness. In order to verify the validity of the choices made, some test cases were performed with simplified models which confirmed the robustness of the method. The application of the method to onboard real time adaptive guidance is considered.

ESA

N92-24454# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany). FALKE: WINGED RE-ENTRY VEHICLE FLIGHT CONTROL

KLAUS-DIETER RELOTIUS and GASTON NETTER / In ESA, Spacecraft Guidance, Navigation and Control Systems p 157-162 Dec. 1991 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany

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The analysis and design of GNC (Guidance, Navigation, and Control) algorithms of winged reentry vehicles like Hermes is based on the knowledge of aerodynamic forces and torques. The properties, i.e., the coefficients for the prediction of aerodynamic coefficients and their derivatives, is one of the most difficult tasks. This is due to the complex coupling between kinematics, aerodynamics, and thermodynamics. An understanding of the interdependencies is needed to enable a realistic analysis of flight performance and flight qualities. The prediction of aerodynamic properties is generally obtained by numerical methods. The verification of the results is acquired by wind tunnel tests. In practice the verification turns out to be rather difficult mainly due to the lack of wind tunnel capability to simulate the correct Reynolds and Mach number ranges. An alternative method to obtain aerodynamic coefficients and their derivatives is to perform free flight tests with a scaled down flight model. Predefined maneuvers are executed. The offline analyses of flight data provides the unknown coefficients. To prove the feasibility of this method is one of the main objectives of the FALKE project. ESA

N92-24467# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div. MANAGEMENT OF NAVIGATION MEANS FAILURE IN HERMES SPACE VEHICLE

M. C. CAPDEVIELLE and T. ABENSUR / In ESA, Spacecraft Guidance, Navigation and Control Systems p 257-260 Dec. 1991

Copyright Avail: CASI HC A01/MF A06

Hermes space vehicle uses a complex navigation system involving numerous items of onboard equipment (Inertial Measurement Units stellar sensors, rendezvous sensors, radio altimeters, etc.) and external means (Global Positioning System/Data Relay Satellite, Trident 4 beacons) necessary to ensure accuracy, reliability and security constraints during all flight phases: launch, orbit and reentry. The treatment of navigation means failure has to comply with these high level requirements and must avoid too high complexity to allow simple development and verification. The Hermes navigation system is described phase

by phase. Principles of failure management are given, including segregation, location of votes, and use of backup systems. Various types of failure treatment are depicted, such as hot or cold redundancy, failure detection isolation and recovery, and fault tolerance. General principles of voting techniques are described. Space avionics constraints are qualitatively taken into account regarding several aspects: computer voting constraints, reusability or not of partially failed chains, guidance, navigation and control computation load, and data exchange between computers. The described principles can be generalized to other space avionic systems using hybridation techniques associated to redundancies, as far as manned or unmanned transportation systems are concerned. ESA

N92-24471# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div. ROBUST CONTROL OF AN AERODYNAMICALLY UNSTABLE LAUNCHER WITH BENDING MODES

S. BESSET and P. DELPY / In ESA, Spacecraft Guidance, Navigation and Control Systems p 287-292 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

The application of H(infinity) control theory to the design of robust control laws for an aerodynamically unstable launcher is explored. A specific robust control design methodology is presented. The new approach incorporates nonlinear multiparameter variations in the state space formulation of H(infinity) control theory. The controller design technique is successfully applied to an aerodynamically unstable launcher whose dynamical behavior along a reference trajectory is modeled taking into account the angle of attack deviation, the thruster gimbal axis deflection and the bending modes. A robust controller is designed in order to stabilize the nominal system and the perturbed one with parameter uncertainties on the main aerodynamic coefficient, in the gimbal effectiveness coefficient and on the bending modes frequencies. The focus is on the use of the synthesis technique as a powerful loop shaping tool to yield frequency domain properties known to be desirable. ESA

N92-24474# Officine Galileo S.p.A., Florence (Italy). FULL MACS CONTROLLER-BASED SELF TEST MODULE FOR SPACECRAFT UNITS AND RELATED TESTING FACILITIES

G. BORGHI (Officine Galileo S.p.A., Florence (Italy).), P. BRAZZALE (European Space Research Lab., Noordwijk (Netherlands).), M. BRUNAMONTI (Protech, Florence (Italy).), M. MANCINI (Officine Galileo S.p.A., Florence (Italy).), and S. TOSI (Protech, Florence, Italy) / In ESA, Spacecraft Guidance, Navigation and Control Systems p 311-313 Dec. 1991

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The development of a Self Test Module (STM) for IRES sensor and the related Electronic Ground Support Equipment (EGSE) is described. STM is an embedded general purpose testing module for space equipment; the IRES sensor is the first application. As a result of the work carried out, a method to design and develop a general purpose test station for MACS (Modular Attitude Control System) interfaced devices is described. ESA

N92-24493# VEGA Space Systems Engineering Ltd., Harpenden (England). OBJECT-ORIENTED SIMULATION IN DIAGNOSIS AND RECOVERY FROM FAULTS IN SPACECRAFT SUBSYSTEMS: AN EXPERIMENTAL APPLICATION OF THE OLYMPUS AOCS

R. S. THOMPSON (VEGA Space Systems Engineering Ltd., Harpenden (England).) and P. L. SILVESTRI (European Space Agency, European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) / In ESA, Spacecraft Guidance, Navigation and Control Systems p 467-472 Dec. 1991

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Work on the feasibility of developing expert systems, which can automatically generate the contingency recovery procedures required to diagnose and recover from an entire class of predictable failure cases onboard an orbiting spacecraft is discussed. This is based on a layered, object oriented model of the spacecraft subsystem concerned, combining structural, behavioral and

strategic knowledge. A case study for the Olympus AOCS (Attitude and Orbit Control System) is described. Replacement of the expert system's strategic layers with alternative rule sets, could lead to similar tools being used for operability and failure mode analysis during design, amongst other uses, and ultimately offers the prospect of onboard automated fault detection, isolation and recovery. ESA

N92-24494# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

CONTROL STRATEGIES FOR SPACE SYSTEMS

S. STORNELLI (European Space Research Lab., Noordwijk (Netherlands)), J. RAMAKRISHNAN (DYNACS Engineering Co., Inc., Clearwater, FL.), H. RAJIYAH (General Electric Co., Schenectady, NY.), and A. SILVA (Agusta S.p.A., Milan, Italy) *In its* Spacecraft Guidance, Navigation and Control Systems p 475-482 Dec. 1991

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Methodologies for optimization of control structure synthesis are proposed for a class for structures which can be modeled as an assemblage of frame and truss elements. It is assumed that the structure and control system can be represented as a linear model. Three different approaches are proposed: local control structure optimization wherein feedback gains associated with local controllers are treated as design variables and the objective function is taken as the total controller forces and constraints are imposed on maximum dynamic displacements and individual local controller forces; an integrated Modal Cost Analysis (MCA) Output Variance Constraints (OVC) approach wherein an LQ controller is designed iteratively subject to $L(2)$ and $L(\infty)$ constraints on outputs based in the truncated modes of the structure (based on MCA approach); a global full state (LQR) control structure optimization approach where minimization of a linear combination of structural mass and controller energy is carried out subject to constraints on the natural frequency of the structure. The actuators and sensors are assumed to be collocated for the local controller problem. ESA

N92-24495# MATRA Espace, Toulouse (France).

MODERN CONTROL TECHNIQUES FOR SPACECRAFT AOC/GNC SYSTEMS

C. CHAMPETIER (MATRA Espace, Buc (France)), E. DESPLATS (MATRA Espace, Buc (France)), and P. PELIPENKO (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 483-490 Dec. 1991

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The results of studies dedicated to the applicability of modern control techniques to future spacecraft AOC/GNC (Attitude and Orbit Control/Guidance, Navigation and Control) systems are presented. A (nonexhaustive) review of current and future space missions which are likely to claim for the utilization of modern control theory is performed. A set of modern control techniques among the most promising ones is presented. The applicability of these methods to space control systems is discussed. Two typical applications selected for practical evaluation of modern control techniques and comparison with classical ones are described. ESA

N92-24496# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).

SPACECRAFT ATTITUDE CONTROL USING MAGNETIC TORQUERS AND GAS JETS

R. PRIGGE, H. KLOTZ, and H. STRAUCH *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 491-496 Dec. 1991 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany

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The attitude control of a spacecraft in low Earth orbit, equipped with magnetic torques and gas jets, is described. Starting with the determination of the theoretical minimum propellant mass required, optimum control laws are derived. A number of control strategies

are investigated, different with respect to the use of a priori knowledge of the gravity gradient torque, and to various techniques for disturbance torque estimation. Magnetic field estimation of geostationary orbits is also addressed. ESA

N92-24499# Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. des Signaux et Systemes.

ON THE NONLINEAR ADAPTIVE CONTROL OF A FLEXIBLE SPACECRAFT

G. GEORGIOU (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France)), S. DIGENNARO (Universita degli Studi della Basilicata, Potenza (Italy)), S. MONACO (Rome Univ., Italy), and D. NORMAND-CYROT *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 509-514 Dec. 1991 Sponsored in part by Italian Ministry of University and Scientific Technological Research and Commission of the European Communities

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Gradient type adaptation laws, together with a certainty equivalence control law derived from nonlinear decoupling and linearization techniques, are applied to the model of a spacecraft with flexible appendages in order to achieve asymptotic tracking on the presence of unknown parameters. Uncertainties in the inertia tensor and on the modal parameters (natural undamped frequencies and damping coefficients) are considered. The proposed control scheme is shown to asymptotically track the desired reference trajectories for large attitude maneuvers, ensuring the whole control system stability. Simulation results are discussed. ESA

N92-24504# British Aerospace Public Ltd. Co., Stevenage (England).

SOME ASPECTS OF THE ATTITUDE AND ORBIT CONTROL SUBSYSTEM OF THE OLYMPUS SPACECRAFT

P. D. WADEY, P. E. MILES, and R. K. LOWES *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 545-549 Dec. 1991

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The Olympus spacecraft was launched in 1989 with a number of new and interesting features in attitude and orbit control design. The AOCS (Attitude and Orbit Control System) is described and results obtained with the AOCS in transfer orbit are given. The normal and station keeping modes are discussed together with a novel method of performing east-west station keeping developed during the early months of the mission. The results of analysis of the solar array flexible modes using inflight data from an accelerometer package and the gyros is presented, and a comparison of actual sloshing induced momentum and torques with the predicted values from the Olympus AOCS simulator linked to Flow-3d (three dimensional flow software) is given. ESA

N92-24510# British Aerospace Public Ltd. Co., Stevenage (England). Earth Observation and Science Div.

THE DYNAMICS OF THE CLUSTER SPACECRAFT

C. A. STEPHENSON *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 589-594 Dec. 1991

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Although the cluster spacecraft is basically a simple, highly stable spinner, its dynamics and its AOCMS (Attitude and Orbit Control and Maneuver System) poses a number of unusable and interesting features. The spacecraft contains large quantities of liquid propellant and, in orbit, deploys eight booms. Four of these booms are cable booms, each 50 m in length. The spacecraft is maneuvered extensively in the deployed configuration and the response of the deployed spacecraft to maneuvering are discussed, together with the analytical tools and software packages used to support the investigations. ESA

N92-24721# Satellite Operational Services G.m.b.H., Gilching (Germany).

APPROACH TO THE EVALUATION OF INTERFERENCES BETWEEN CO-LOCATED GEOSTATIONARY SPACECRAFT

ALEXANDER HAERTING *In* ESA, Spacecraft Flight Dynamics p

11-16 Dec. 1991

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Interferences other than collisions between colocated geostationary satellites are addressed. These may result in shadowing and disturbances of the radio frequency link or attitude sensors. A software tool for computing line of sight geometries is introduced. Applications to orbit simulations of currently accepted candidates for colocation strategies are presented and evaluation criteria are discussed. Quantitative statements about the significance of interferences are not made, but it seems that additional limits on the separation parameters may arise for some strategies. ESA

N92-24724# Mathematischer Beratungs- und Programmierungsdienst G.m.b.H., Dortmund (Germany). Software and Systems Div.

PHOTOGRAPHIC OBSERVATIONS OF THE CO-LOCATED SPACECRAFT AT 19 DEG WEST

HERMANN BOEHNHARDT /in ESA, Spacecraft Flight Dynamics p 27-32 Dec. 1991

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During an asteroid astrometric campaign conducted Apr. 10-22, 1991 at the European Southern Observatory (ESO) in La Silla (Chile), subsidiary observations were made of geostationary satellites positioned above 19 deg west longitude using the 40 cm GPO astrograph. These observations, recorded on 2 by 2 deg field of view photographic plates, clearly show the presence of TDF-1 and 2 (18.7 to 18.9 deg west), Olympus (18.9 to 19.1 deg west) and TV-SAT-2 (19.1 to 19.3 deg west) positioned about this point. The exposures demonstrate the changes in the relative positions of the satellites due to drift motion and orbital maneuvers. The observations of Apr. 17-22, 1991 also document the deadband violation of Olympus which drifted through the TDF longitude window. On Apr. 22, 1991, a multiple exposure of the 19 deg west geostationary longitude was collected. Eleven 5 minute exposures, each separated by 60 or 30 minutes, were obtained in a single photographic plate, thus recording the daily libration of the satellites as well as their brightness variation due to changing solar illumination. At least three other geostationary or near geostationary objects are visible in this plate, hence identified as 1983-47-A or Intelsat 5 F-6 1988-71-D part of the launch of Gorizont 16 and 1990-112-D upper stage of the Raduga 26 launch. The exposures may support calculations of angular separations between the satellites to an accuracy of the order of 1 to 2 arcsec, corresponding to 200 to 400 m projected intersatellite distance in geostationary orbit. ESA

N92-24728# Zaragoza Univ. (Spain). Grupo de Mecanica Espacial.

RELEGATION OF THE PROPER ROTATION IN ATTITUDE DYNAMICS OF A SPACECRAFT

A. ELIPE, M. ARRIBAS, and J. PALACIAN /in ESA, Spacecraft Flight Dynamics p 55-59 Dec. 1991

(Contract CICYT-PB90-0921; CICYT-ESP91-0919)

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The problem of the coupled motion orbital rotational of a satellite with three different axes of symmetry in fast rotation is considered. The principal term (of order 0) is made of two parts: the part $H(K)$ describing the motion of the center of mass of the satellite about the planet is expressed in terms of the Whittaker variables, and the part $H(E)$ accounting for the rotation of the satellite about its center of mass in the absence of external forces which is expressed in terms of the Serret-Andoyer variables. The difficulty of building a generating function for a Lie transformation that removes the angle g in the perturbation is resolved by applying the 'relegation of the node' technique. The development is performed symbolically. At each order, the generating function is built recursively: trigonometric terms appeared with powers of the parallax factor of increasing exponents. The iteration is stopped

when it reaches powers that are too small to affect significantly the normalized system. ESA

N92-24755# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Space Dynamics Section.

ESTIMATION OF ATTITUDE THRUSTER ACTIVITY OF SPACECRAFT ON SUN ACQUISITION MODE

O. MONTENBRUCK and E. GILL /in ESA, Spacecraft Flight Dynamics p 275-278 Dec. 1991

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In the course of positioning the phase of Eutelsat 2 F1 and F2, notable orbit perturbations were observed when the satellites were in Sun Acquisition Mode (SAM). Analysis of the tracking data residuals indicated a type of perturbation similar to the effect of the solar radiation pressure. Investigating various possible explanations it became clear that the effect could be attributed to the attitude thruster activity in SAM. In this mode, thrusters facing the Sun are used to control the pitch axis, while thrusters in the opposite side are used for yaw axis control. Since the acceleration due to each thruster has a considerable component along the rotation axis, a continuous attitude control results in an effect similar to the solar radiation pressure. A detailed analysis of the thruster on time telemetry together with information on expected thruster performance was used to model the observed perturbations for different types of orbits. ESA

N92-25828# European Space Agency, Paris (France).

FOURTH EUROPEAN SYMPOSIUM ON SPACE ENVIRONMENTAL CONTROL SYSTEMS, VOLUME 1

T.-DUC GUYENNE, ed. and JAMES J. HUNT, ed. Dec. 1991 560 p Symposium held in Florence, Italy, 21-24 Oct. 1991 (ISSN 0379-6566)

(ESA-SP-324-VOL-1; ISBN-92-9092-138-2; ETN-92-91355)

Copyright Avail: CASI HC A24/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Papers of the fourth European symposium on space environmental control systems covering activities in space thermal control, life support and habitability are presented. Subjects covered range from cryogenic cooling to reentry thermal protection systems, from atmosphere management to water and waste management and from internal architecture to astronaut food selection. In volume 1 the following topics are particularly addressed: the International Space Station; heat transport systems; general ECLSS (Environmental Control and Life Support System); analytical tools (thermal); cryocoolers and refrigerators; thermal control systems; Columbus trace gas control and contamination; analytical tools (fluids); cryocoolers (very low temperatures); analyses, verification and testing; air revitalization and monitoring analytical tools (ECLSS); heat rejection; heat pipes and two phase technology. ESA

N92-25834# Dornier System G.m.b.H., Friedrichshafen (Germany).

TWO-PHASE THERMAL TECHNOLOGY FOR SPACE APPLICATION: DEVELOPMENT STATUS

H. G. WULZ and R. SIEPMANN /in ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 69-76 Dec. 1991

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In 1983 a program to explore the necessity of two phase systems as highly efficient thermal control systems for future space projects was initiated. Now, after 8 years of development, a solid basis in the field of thermal technology has been reached. New thermal concepts such as two phase heat transport systems, heat pipes, thermal connectors and radiating systems have been developed and proven in comprehensive ground tests. The actual status of development of three main European two phase thermal technology programs is summarized. The objective of these projects is to elaborate the technological basis for the development of

new, most effective heat transport systems for future manned and unmanned spacecrafts. ESA

**N92-25859# MATRA Marconi Space, Toulouse (France).
SOHO: A CHALLENGE IN SPACECRAFT THERMOELASTIC
DESIGN AND VERIFICATION**

P. AYACHE (European Space Agency, Paris (France).), M. CISLAGHI (European Space Agency, Paris (France).), K. DUMMER (European Space Agency, Paris (France).), and S. HARVEY (MATRA Marconi Space, England) /n ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 265-271 Dec. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

An introduction to the mission purposes, the payload, and the main SOHO (Solar and Heliospheric Observatory) features is given and the key thermoelastic problem is addressed through the presentation of the very tight pointing requirements imposed by the experiments in the spacecraft structure, and through the description of the basic design aspects consequently chosen. The analytical verification aspects are addressed and some preliminary results obtained through ESATAN (ESA Thermal Analysis Network) modeling are presented. Design driving elements are identified and present criticalities and/or open points are discussed. ESA

**N92-25881# Alenia Spazio S.p.A., Turin (Italy).
A SYSTEMATIC APPROACH TO THERMAL BALANCE TEST
EVALUATION AND THERMAL MATHEMATICAL MODEL
CORRELATION FOR SPACECRAFT THERMAL DESIGN**

LAZZARO COSTAMAGNA, VALTER PEROTTO, and ENRICO SACCHI /n ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 425-431 Dec. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A Thermal Balance Test (TBT) definition, performance, and result evaluation, in the frame of the thermal design verification activities is presented. It is based on the test and correlation performed for the following projects: Sirio, Olympus, Iris, Italsat, Eutelsat 2, Eureka, Tethered, and SAX. Some flight data is also presented and discussed. ESA

**N92-32834# National Aerospace Lab., Amsterdam (Netherlands).
Space Div.**

**INVESTIGATIONS PREPARATORY TO THE WET SATELLITE
MODEL EXPERIMENT**

J. P. B. VREEBURG 30 Jun. 1991 18 p Presented at the International Symposium on Hydromechanics and Heat/Mass Transfer in Microgravity, Perm-Moscow, USSR, 6-12 Jul. 1991 (NLR-TP-91219-U; ETN-92-92005) Avail: CASI HC A03/MF A01

The Wet Satellite Model (WSM) Experiment is to be executed with a small spacecraft that has a tank partially filled with liquid. The spacecraft is instrumented with a distributed arrangement of linear accelerometers in order to determine its angular and translational motions. From these data, the forces and moments exerted by the liquid on the rigid part of the spacecraft are to be calculated. Investigations on different subjects were conducted in preparation of the experiment. These concern the formulation of the dynamic behavior of the spacecraft, the stability of various spacecraft configurations, the arrangement of the accelerometers, and some practical difficulties. For numerical simulation of the dynamics of the spacecraft, use is made of a computer program having a routine that simulates the behavior of liquid in microgravity and under capillary forces. A breadboard model of the spacecraft was operated during aircraft parabolic flight. This environment is not suitable for investigations on a model with a partially filled tank but provides useful results with empty or completely filled tanks. The planned further development of the WSM Experiment is elaborated. ESA

N92-70065*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

**SCOLE DYNAMIC ANALYSIS AND FREQUENCY RESPONSE
USING DISTEL SOFTWARE**

D. POELAERT /n NASA. Langley Research Center, Spacecraft Control Laboratory Experiment (SCOLE) Workshop, 1984 p 41-86 1984

Avail: CASI HC A03/MF A04

The distributed element dynamic analysis package DISTEL is used to analyze the NASA/Institute of Electrical and Electronics Engineers' Spacecraft Control Laboratory Experiment (SCOLE). In this configuration, the Space Shuttle motion is coupled to the motion of a large dish antenna through a Shuttle-deployed flexible mast of 40 m long. Due to the high asymmetry of the system, the motions about the different axes (roll, pitch, yaw) are severely coupled. A general purpose software like DISTEL is especially suited for this kind of analysis. Modal frequencies of the complete spacecraft and impulse response (modal gains) to excitations at different locations are obtained. Mode-shape plots of the deformations of the entire system are given. Finally, results obtained at NASA and at Purdue University are compared to those found by the European space technology center, ESTEC. Author

19

SPACECRAFT INSTRUMENTATION

**A92-49258
IS THE AVIONICS SYSTEM OF THE HERMES SPACEPLANE
CENTRALIZED OR DECENTRALIZED?**

JEAN-CLAUDE VANNIER (Aerospatiale, Division Systemes Strategiques et Spatiaux, Les Mureaux, France) IN: IEEE/AIAA Digital Avionics Systems Conference, 10th, Los Angeles, CA, Oct. 14-17, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 38-42.

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The avionics system of Hermes is called spacionics. Spacionics is defined as a set of onboard items which treat, exchange, or store information in electrical form, and provide and distribute electrical power. The main drivers for spacionics design are mass and safety. The spacionics organization depends on the priorities assigned to different criteria. These priorities can lead to either a centralized or a decentralized data processing architecture. It has been necessary to centralize the widest part of the data processing, which is split into two pools of computers, one dedicated to guidance, navigation and control and one dedicated to mission and vehicle management. The first one, made of 4 computers and 4 data busses, is able to perform its functions autonomously and automatically even after 2 failures. The second one, including only 2 strings, requires the implementation of safety protection, activated, if necessary, either by the crew or by the control. I.E.

A92-53412* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**DUAL TECHNIQUE MAGNETOMETER EXPERIMENT FOR THE
CASSINI ORBITER SPACECRAFT**

D. J. SOUTHWOOD, A. BALOGH (Imperial College of Science, Technology, and Medicine, London, United Kingdom), and E. J. SMITH (JPL, Pasadena, CA) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 9, Sept. 1992, p. 371-374. refs Copyright

The dual technique magnetometer to fly on the Cassini Saturn Orbiter Spacecraft is described. The instrument combines two separate techniques of measuring the magnetic field in space using both fluxgate and vector helium devices. In addition, the instrument can be operated in a special scalar mode which is to be used near the planet for highly accurate determination of the interior

19 SPACECRAFT INSTRUMENTATION

field of the planet. As well as the planetary field, the instrument will make large contributions to the scientific measurements of the planetary magnetosphere, the highly electrically conducting region of space surrounding Saturn permeated by the Saturnian field, the interaction of Saturn and the interplanetary medium and the interaction of Titan with its space environment. Author

A92-53415

THE ELECTRON SPECTROMETER FOR THE CASSINI SPACECRAFT

A. J. COATES, C. ALSOP, A. J. COKER, D. R. LINDER, A. D. JOHNSTONE, R. D. WOODLIFFE (London, University College, Dorking, United Kingdom), M. GRANDE, A. PREECE, S. BURGE, D. S. HALL (Rutherford Appleton Laboratory, Didcot, United Kingdom) et al. British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 9, Sept. 1992, p. 387-392. Research supported by SERC and Royal Society. refs
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One of the major aims of the Cassini spacecraft is to characterize in detail the interaction of the solar wind with the Saturnian system. The Cassini Plasma Spectrometer (CAPS) addresses this aim by measuring the plasma particles, ions and electrons, with a suite of three complementary state-of-the-art sensors. The Electron Spectrometer (ELS), contributed by the UK with assistance from Norway, will measure the energy and angular distributions of solar wind and magnetospheric electrons with unprecedented accuracy. This paper describes the scientific aims and design of CAPS concentrating particularly on the ELS sensor. Author

N92-10563# Helsinki Univ. of Technology, Espoo (Finland). Astrophysics Lab.

THE MEASURING MODES AND OBSERVATIONS WITH THE X-RAY SPECTROMETER ARRAY SIXA ONBOARD SPECTRUM-X-GAMMA Abstract Only

J. HUOVELIN (Helsinki Univ. (Finland).), H. PAEVIKKE (Technical Research Centre of Finland, Oulu.), O. VILHU (Helsinki Univ. (Finland).), and V. KAEMAEAEINEN (Outokumpu Oy, Tapiola, Finland) /n Oulu Univ., Proceedings of the 25th Annual Conference of the Finnish Physical Society 1 p 1991
Avail: CASI HC A01/MF A03

The Spectrum-X-Gamma satellite is scheduled for launch in 1993, and one of the main instruments on the satellite will be the Silicon X-ray Array (SIXA). A Finnish consortium is constructing this in collaboration with Denmark and USSR. A project at the University of Helsinki is responsible for the definitions of the measurement modes available in SIXA, and planning of its scientific usage. The instrument is a 1024 channel spectrometer with 19 elements in the energy range from 0.5 to 30 keV. It is programmed to work in several modes to adjust for various observing programs and targets. The properties are described, the use of these modes are discussed, and the scientific perspectives of SIXA are reviewed. ESA

N92-10565# Oulu Univ. (Finland). Dept. of Physics.
CAPS-PLASMA SPECTROMETER FOR THE CASSINI SPACECRAFT Abstract Only

P. TANSKANEN (Oulu Univ. (Finland).), K. MURSULA (Oulu Univ. (Finland).), V. KELHA (Technical Research Centre of Finland, Espoo.), and H. HUOMO (Technical Research Centre of Finland, Espoo.) /n its Proceedings of the 25th Annual Conference of the Finnish Physical Society 1 p 1991
Avail: CASI HC A01/MF A03

The Space Physics group at the Department of Physics, University of Oulu together with the Instrument Laboratory of the Technical Research Center of Finland will take part in the science definition, design and fabrication of the Ion Beam Spectrometer (IBS) to be included as one of the three spectrometers to be built in the CAPS plasma spectrometer instrument. CAPS will also include an ion mass spectrometer and an electron spectrometer. All instruments will be designed and built, using the state of the art technique based on a long term heritage of participating

co-investigator institutes. A description the Cassini project, of the IBS instrument as well as of the goals of the mission, is given.

ESA

N92-24458# Satellites International Ltd., Newbury (England).

LOW COST SPACECRAFT ATTITUDE SENSORS

M. R. LEESE, A. K. WARD, S. PAICE, and S. HEYHOE /n ESA, Spacecraft Guidance, Navigation and Control Systems p 189-194 Dec. 1991

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With the increasing interest in small satellites there is a growing requirement for low cost attitude sensing and control systems. The development of such a low cost attitude sensing system, suitable for spinning spacecraft is described. The attitude sensor system uses fan beam Sun and Earth albedo sensors based on those used successfully on the Active Mesospheric Particle Tracer Explorer (AMPTE) mission. The sensors interface to an electronics module which records the timing of the triggers on the Sun and Earth, which data can then be processed for attitude determination. The system is to be flown on the Space Technology Research Vehicle (STRV-1) currently under development. STRV-1 is to be launched in early 1993 into a Geostationary Transfer Orbit (GTO). The sensors and electronics module are designed to withstand the GTO high radiation environment whilst minimizing the power requirements. The electronics module are designed to withstand the GTO high radiation environment whilst minimizing the power requirements. The electronics module employs Field Programmable Gate Array (FPGA) devices which are inherently radiation hard. The way in which attitude reconstruction is performed by software running on the onboard computer or by ground based software is described. Further development of attitude sensing and control systems, including a low cost digital Sun sensor suitable for three axis stabilized spacecraft, is described. ESA

20

SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

A92-31709#

BENEFITS OF ELECTRIC PROPULSION FOR ORBIT INJECTION OF COMMUNICATION SPACECRAFT

F. PORTE, P. SAINT AUBERT, and C. BUTHION (Matra Marconi Space, Villacoublay, France) AIAA, International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992. 10 p. Research sponsored by INTELSAT. (AIAA PAPER 92-1955) Copyright

This paper presents an analysis of the benefits of electric propulsion (Xenon Ion Propulsion systems and Thermal Arcjets) when applied to the orbit raising of communication spacecraft. Three different injection strategies are proposed and assessed. The impacts on the spacecraft design and the associated dry mass penalties are introduced in the analysis. Finally, the benefits in terms of launch cost reduction or payload extension are discussed. Author

A92-40455

DIFFERENT SPACE ELECTROCHEMICAL CONVERSION AND STORAGE SYSTEMS

G. GAVE (CNES, Toulouse, France) IN: SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, p. 430-436.

It is noted that in most cases, spacecraft electric power sources comprise energy and storage conversion devices that operate by electrochemical means. The major primary and secondary electrochemical couples utilized are described in terms of their

principal characteristics, the state of the art and the enhancements that are to be developed. The adaptability of these solutions to different space missions and the thrust of investigation to fulfill future needs for energy production in space are discussed.

R.E.P.

A92-57299

NEAR-FIELD EXPANSION IN THRUSTER PLUMES

CARL DANKERT and GEORG DETTLEFF (DLR, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1003-1010. refs

(Contract ESA-6829/86/NL/PH(SC))

Copyright

An experimental study was conducted on the near-field properties of plumes emanating from a conical attitude-control thruster nozzle. The nozzle Reynolds number of the original hydrazine-fueled thruster was duplicated with nitrogen as test gas. Three types of measurements were made: velocity measurements with the electron beam technique, pitot pressure surveys on-axis and perpendicular, and streamline detection by ion-tracing with the electron beam. For the near-field flow of the conical nozzle the concept of two separate flow types (isentropic core and boundary layer) could be confirmed for Re greater than 800. With increasing boundary layer thickness the isentropic core changes. The normalized density increases; the Mach number and velocity decrease; and the flow becomes less divergent.

Author

A92-54208#

BI-PROPELLANT THRUSTER FAMILY FOR SPACECRAFT PROPULSION

M. A. SCHWENDE, G. MUNDING, and G. SCHULTE (MBB GmbH, Munich, Germany) AIAA, SAE, ASME, and ASCE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 12 p. (AIAA PAPER 92-3860) Copyright

In the past 20 years MBB/DASA has developed two types of satellite propulsion thrusters, 10 N and 400 N, which are now operating in twelve satellites. The history of first generation satellite propulsion thrusters is presented. Second generation thrusters have been developed for improved performance and operating range. The present status of development and applications of second generation thrusters with swirl atomizing injection systems and two types of film-radiative cooling are discussed. Development of second generation thrusters started with the 4 N thruster for high accuracy attitude control followed by 10 N thrusters for orbit and attitude corrections. Development of the 4 N thruster should be completed in 1992/93. A third thrust level, 400 N, for more efficient apogee injection, is being prepared and should be completed in 1993/94. Details on material selection, joining technology for different materials and performances achieved are presented. Present and future applications of second generation thrusters are discussed as well as the advantages of using one type of high performance bi-propellant thruster technology.

A.O.

A92-56849#

A COMPARISON OF NUMERICAL PREDICTIONS AND EXPERIMENTS ON UNDER-EXPANDED JETS

T. M. CAIN, N. A. MORRIS (Oxford, University, United Kingdom), T. P. ROBERTS (Fluid Gravity Engineering, Ltd., Witley, United Kingdom), and T. V. JONES (Oxford, University, United Kingdom) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 15 p. Research supported by Ministry of Defence Procurement Executive. refs

(AIAA PAPER 92-4027) Copyright

Some under-expanded jets were investigated experimentally as a step toward validating computational codes used for predicting rocket exhaust-plume signatures. Numerical predictions of plume-shock shapes and pitot pressure distributions are compared with experimental results for a plume formed by a cluster of four nozzles exhausting into a quiescent low pressure tank. Measurements are also presented for single nozzle jets exhausting

into a coflowing hypersonic stream. The pressure ratios, N, were of the order 1000 and plume Reynolds numbers were greater than 10,000 and so the jets' shear layers were turbulent and hypersonic. The jets are similar, in this respect, to rocket exhaust plumes formed at altitudes below 70 km.

Author

A92-57061

PLASMA THRUSTER DEVELOPMENT PROGRAM AT THE IRS M. AUWETER-KURTZ (Stuttgart, Universitaet, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 13 p. refs

(IAF PAPER 92-0610) Copyright

The current status of the plasma thruster development program at the Institute of Space Systems (IRS) of the University of Stuttgart is reviewed. Continuously running MPD thrusters up to the megawatt level are currently under development. The objective of this work at IRS is to identify and avoid critical regimes of operation and predict the performance of high-power MPD thrusters. The development program for thermal arcjets is more flight oriented. The discussion includes a description of the IRS facilities and highlights of the MPD thruster and thermal arcjet development programs.

V.L.

A92-57090

PLUG ENGINE SYSTEMS FOR FUTURE LAUNCH VEHICLE APPLICATIONS

H. IMMICH, D. E. KOELLE (MBB GmbH, Munich, Germany), and R. C. PARSLEY (Pratt & Whitney Group, West Palm Beach, FL) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 13 p. refs

(IAF PAPER 92-0647) Copyright

Several feasible design options are presented for plug engine systems designed for future launch vehicle applications, including a plug nozzle engine with an annular combustion chamber, a segmented modular design, and an integration of a number of conventional engines around a common plug. The advantages and disadvantages of these options are discussed for a range of potential applications, which include single-stage-to-orbit vehicles and upper stage vehicles such as the second stage of the Saenger HTOL launch vehicle concept.

I.S.

N92-13155# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

POWER SYSTEM PERFORMANCE PREDICTION FOR THE HIPPARCOS SPACECRAFT

R. L. CRABB, J. E. HAINES, E. J. DALY, DERMOT M. OSULLIVAN, G. DUDLEY, A. K. SEPERS, and H. K. FIEBRICH In its European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 9-18 Aug. 1991 Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

Following the August 1989 launch of the Hipparcos Spacecraft, a failure in the Apogee Boost Motor (ABM) system resulted in the mission being permanently constrained to the very damaging radiation environment of the geosynchronous transfer orbit. The electrical power implications that faced the Hipparcos Spacecraft at that time are described and the analyses conducted and the performance predictions made are presented. How a mission survival assessment was made for both the critical February/March 1990 eclipse period and for the overall lifetime of the spacecraft, with the aid of a spreadsheet program, is described. Predictions made against the actual results obtained during the February/March 1990 eclipses are compared and from this correlation conclusions for the remaining period are drawn.

ESA

N92-13174# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

ESA POWER STANDARD

H. SPRUIJT, P. PEROL, and A. HOGSHOLM (Danish Space Research Inst., Lyngby.) In its European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel

20 SPACECRAFT PROPULSION AND POWER

Cells p 145-150 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The ESA Power standard, its objectives and its capability are introduced. The standard contains two parts: (1) general requirements containing only general statements and formulas; and (2) the template of the specification format, which shall be updated during the development phases of a satellite application. This standard is supported by a rationale explaining the parameters specified in the standard together with example cases. ESA

N92-13176# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

PROTECTION CONCEPTS USED IN SPACECRAFT POWER SYSTEMS

DERMOT LEVINS *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 157-162 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

Some of the protections used in spacecraft power system designs or which have been forgotten or rejected on the assumption that they were unnecessary are addressed. Protection is one of the more critical features of any reliable design, unfortunately its omission is often only recognized in hindsight and in spacecraft applications this can be catastrophic. ESA

N92-13236# Dornier System G.m.b.H., Friedrichshafen (Germany).

HOLOGRAPHIC DISPERSIVE CONCENTRATORS FOR PHOTOVOLTAIC POWER GENERATORS

G. REICH (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).), W. DENNER (Technische Hochschule, Aachen (Germany, F.R.)), K. BOGUS, C. G. STOJANOFF, and H. W. SCHOCK (Stuttgart Univ., Germany, F.R.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 561-566 Aug. 1991
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Photovoltaic (PV) generators based on different semiconductor materials with optimized band gaps can achieve higher efficiency values than those obtained with single junction solar cells. With simultaneous concentration of the incident solar radiation a further improvement of the efficiency is realized. Based on PV space solar generator technology and terrestrial holographic concentrator technology a system analysis is performed that investigates the feasibility of a Holographic Dispersive Solar Generator (HDSG) for space application. The holographic solar concentrator allows simultaneous splitting and concentration of the incident sunlight. The upper limits of concentrator efficiency, spectral bandwidth and concentration ratio of holographic dispersive concentrators are evaluated with respect to the space environmental conditions. Two concepts of photovoltaic power generators with holographic dispersive concentrators for space application are described. ESA

N92-18636# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Design Assurance Dept.

INTEGRATION OF RAMS ACTIVITIES DURING THE DEVELOPMENT PHASE OF ARIANE-5 COMPONENTS (EXAMPLE: VULCAIN THRUST CHAMBER)

CLAUDIA LEX *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 175-178 Aug. 1991 (MBB-UK-0144-PUB; OTN-033152) Copyright Avail: CASI HC A01/MF A03

In order to assure the implementation of Reliability, Availability, Maintainability and Safety (RAMS) aspects at an early stage and during the complete development of a product, appropriate tools have to be set up for a proper RAMS management function. The policy and methodology applied for management of RAMS information within the VULCAIN thrust chamber development are described. The performance of the described activities is defined

by a dedicated RAMS plan for Ariane 5 propulsion projects at MBB-OTN which meets the requirements of the relevant management specifications for RAMS (dependability) established by CNES for Ariane 5 projects. The described activities are under the responsibility of the RAMS manager for the VULCAIN thrust chamber who is coordinating all RAMS assurance project activities at MBB and at the subcontractors. The RAMS manager is integrated by the project team in order to ensure effective work for RAMS and risk avoidance. The VULCAIN thrust chamber forms part of the cryogenic main stage engine provided for Ariane 5. Its development is performed as an ESA program under the leadership of the CNES. The engine is under the responsibility of SEP who has subcontracted the thrust chamber to MBB-OTN. ESA

N92-22269# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

INTRODUCTION OF THE SOLID FUEL COMBUSTION CHAMBER PROJECT

H. WITTENBERG *In its* Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond p 9-23 1991

Avail: CASI HC A03/MF A03

A survey of some highlights during the eight years of work of the Solid Fuel Combustion Chamber Project (SFCCP) is presented. Objectives and experimental facilities, some important combustion and propulsion parameters, and theoretical research are discussed. Original objectives of SFCCP are concluded to be fulfilled satisfactorily. ESA

N92-22270# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.

THE COPPEF-MODEL FOR SOLID FUEL COMBUSTION CHAMBER PERFORMANCE PREDICTION

P. J. M. ELANDS *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond p 25-51 1991

Avail: CASI HC A03/MF A03

The COPPEF (Computer Program for Parabolic and Elliptic Flows) computer code is described. The equations on which the code is based are treated and the various combustion models, which are implemented in the COPPEF code, are discussed and compared. The computational model, which describes in which way the conservation equations are transformed to a set of equations which can be solved numerically, and the required inlet and boundary conditions are discussed. The procedure to solve the system of equations numerically is addressed. The use of COPPEF on different computer systems is discussed, and some examples of calculations and applications of the code are given. The COPPEF code is concluded to be a powerful tool in the prediction of solid fuel ramjet combustion chamber performance. ESA

N92-22271# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

FUEL PYROLYSIS IN SOLID FUEL COMBUSTION CHAMBERS

J. P. DEWILDE *In its* Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond p 53-72 1991

Avail: CASI HC A03/MF A03

To describe the regression of solid fuels like polyethylene, only monomer formation and a fixed, temperature-independent value for the effective heat of gasification are assumed. From literature, it is found that in reality during the pyrolysis of solid fuels, not only monomer is formed, but also the composition of the pyrolysis product varies with the heating rate and the temperature. This leads to varying values for the effective heat of gasification. A model describing the pyrolysis of solid fuels in more detail was developed. This model gives a relation between the regression rate and the pyrolysis temperature of the solid fuel. Furthermore, it gives the composition of the pyrolysis products and the effective heat of gasification of the solid fuel at the pyrolysis temperature. The pyrolysis model was implemented into a solid fuel ramjet computational fluid dynamics prediction computer code

and allows for the variation of the effective heat of gasification as a function of the combustion conditions as well as a function of the position along the fuel grain. Calculated regression rates were compared with experimental findings. The application of the model has increased the prediction of the regression rates, in particular at high air mass flow rates. This means that an independent model is now available for regression rate prediction, instead of using arbitrarily chosen pyrolysis temperatures and effective heats of gasification. ESA

N92-22275# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.

SPIN-OFFS OF THE SOLID FUEL COMBUSTION CHAMBER PROJECT

P. A. O. G. KORTING /in Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond p 147-170 1991

Avail: CASI HC A03/MF A03

Activities emerging from the SFCC project, which can be denoted as spin-off, are shown. In this respect, the role of the so-called Users Committee is discussed. The activities concerned may be classified into the following categories: programs, products, and services which all have in common that they are initiated, generated, or made possible as a result of the SFCC research program. Programs include the development and production of pyrotechnic devices for Ariane 5 and a ramjet kinetic energy generator feasibility study. Products include the sonic control and measuring choke equipment for gas massflow control and measurements, ultrasonic pulsed echo interface measurement system equipment to measure local instantaneous regression rate of an ablating solid fuel, explosion prevention, and the REAGAS code to simulate the basic mechanism of a gas explosion. Services include integral rocket ramjet tests and aerodynamic heating tests. Aspects of international cooperation emerging from SFCC are discussed. ESA

N92-27148*# Societe des Accumulateurs Fixes et de Traction, Romainville (France). Advanced Battery Div.

PERFORMANCES OF 250 AMP-HR LITHIUM/THIONYL CHLORIDE CELLS

JACQUES GOULARD /in NASA, Marshall Space Flight Center, The 1990 NASA Aerospace Battery Workshop p 441-464 May 1991

Avail: CASI HC A03/MF A10

A 250 Ah lithium thionyl chloride battery is being developed for a booster rocket engine. Extensive cell testing is running to evaluate functional and safety performances. Some results are presented. The lithium/thionyl chloride batteries were selected for their high energy density (low weight) as compared to other sources. The temperature of a lower weight item will be more sensitive to variations of internal and external heat fluxes than a heavier one. The use of high energy density L/TC batteries is subjected to stringent thermal environments to have benefit of energy density and to stay safe in any conditions. The battery thermal environment and discharge rate have to be adjusted to obtain the right temperature range at cell level, to have the maximum performances. Voltage and capacity are very sensitive to temperature. This temperature is the cell internal actual temperature during discharge. This temperature is directed by external thermal environment and by cell internal heat dissipation, i.e., cell actual voltage. Author

23

CHEMISTRY AND MATERIALS (GENERAL)

A92-18002

HYPersonic MATERIALS

FRANK COLUCCI Aerospace Composites and Materials (ISSN 0954-5832), vol. 3, Nov.-Dec. 1991, p. 4-8.

Copyright

An overview is presented of the development work being conducted on titanium matrix composites and other materials for the air-breathing hypersonic NASP. Consideration is given to various composites including, aluminum-lithium alloy, a thermoplastic PEEK matrix, organic composites, refractory composites, and titanium metal matrices. R.E.P.

24

COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

A92-10232

AEROSPACE ARALL - A CHALLENGE FOR THE AIRCRAFT DESIGNER

JAN W. GUNNINK (Akzo, Fibers and Polymers Div., Arnhem, Netherlands) and BOUD VOGELASANG (Delft University of Technology, Netherlands) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1509-1522. refs

Copyright

The application of Aerospace Arall will solve a lot of problems in designing primary as well as secondary structures. This material offers weight savings of more than 30 percent. Originally developed as a fatigue-insensitive material, it turns out that dedicated grades of Aerospace Arall have very high static as well as residual strength and extremely good impact properties. The designer can now tailor materials to their applications. This aspect will be much simpler for Aerospace Arall with its dedicated lay-up and thickness. The allowables and requirements the aircraft designer has to deal with and which impact they have on the application of Aerospace Arall are discussed. Some current aircraft structural designs and applications are examined. Author

A92-15303

USE OF COMPOSITE MATERIALS FOR AERONAUTICAL STRUCTURE

J. ODORICO (Aerospatiale, Suresnes, France) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 11-27.

Copyright

A comprehensive evaluation is presented of the development status of polymeric, metallic, and ceramic matrix composites employing a wide variety of high performance reinforcing fibers. Attention is given to the service temperature ranges in which these various composite compositions are applicable in aerospace vehicles and propulsion systems. Characteristic applications are illustrated. O.C.

A92-20083

THE CONTROL OF INTERFACE AND MICROSTRUCTURE OF SiC/AL COMPOSITES BY SOL-GEL TECHNIQUES

B. KINDL, Y. L. LIU, E. NYBERG, and N. HANSEN (Riso National Laboratory, Roskilde, Denmark) Composites Science and Technology (ISSN 0266-3538), vol. 43, no. 1, 1992, p. 85-93. refs

Copyright

A process and additives have been developed to coat SiC whiskers and particulate reinforcements. The treated whiskers are shown to have low reactivity toward the aluminum matrix and to be well dispersed. The process is simple and inexpensive, and it

is shown that the mechanical properties of the composite materials are improved. Author

A92-35475

WHY COMPOSITES WAIT IN THE WINGS

BILL SWEETMAN Interavia Aerospace Review (ISSN 0020-6512), vol. 47, April 1992, p. 48-53. Copyright

An overview is presented of the development and current status of composites that could become the key aircraft manufacturing materials of the future, but to date, are still difficult and expensive to produce. An engineering revolution is in progress, based on the growing recognition that composite materials are quite unlike metals; not merely better than monolithic metals, composites are often necessary to go forward from where aerospace vehicles are today. Attention is given to various composite materials and the specific structures and parts under consideration for advanced flight vehicles in design and development. R.E.P.

A92-42141

MEETING ON INDUSTRIAL PRODUCTION OF COMPOSITE MATERIALS, MILAN, ITALY, MAY 6, 7, 1991, PROCEEDINGS

I. CRIVELLI VISCONTI, ED. (Napoli, Università, Naples, Italy) Meeting sponsored by Centro Materiali Compositi, European Association of Composite Materials, Alenia S.p.A., et al. Composites Manufacturing (ISSN 0956-7143), vol. 3, no. 1, 1992, 68 p. For individual items see A92-42142 to A92-42147. Copyright

The present conference discusses the analytical modeling of pressure bag technology, antiwear coatings on fiber-reinforced plastics, composite-material laser drilling and cutting by means of excimer and CO₂ sources, diaphragm-forming of powder-impregnated thermoplastics, and the effect of fiber and crystallinity content on the structural relaxation of PEEK. Also discussed are metal-matrix composite fabrication processes for high-performance aerospace structures, pseudoalloy-type composites produced by pressure infiltration, the influence of processing parameters on glass mat-reinforced thermoplastic stamping, and the design of complex shape filament-wound structures. O.C.

A92-45335

TEST TECHNIQUES FOR METAL MATRIX COMPOSITES; PROCEEDINGS OF THE MEETING, LONDON, ENGLAND, NOV. 28, 1990

N. D. R. GODDARD, ED. (BP Research Centre, Sunbury-on-Thames, England) Meeting supported by Institute of Physics and Institute of Metals. Bristol, England/New York, IOP Publishing, Ltd./American Institute of Physics (IOP Short Meetings Series, No. 28), (ISSN 0269-8986), 1991, 162 p. For individual items see A92-45336 to A92-45343. (ISBN 0-85498-530-1) Copyright

The present conference on test methods for metal-matrix composites (MMCs) discusses potential applications of such Al, Ti, and Mg matrix materials, test requirements for aerospace-application MMCs, small-coupon tensile tests for the ranking of monofilament-reinforced Ti-alloy MMCs, and a single-fiber test technique for Ti MMCs. Also discussed are test methods for small quantities of MMC material, fatigue crack growth in continuous fiber-reinforced MMCs, fatigue crack propagation testing of particulate-reinforced MMCs, fracture-toughness testing of MMCs, and the launching of a U.S. national forum on MMCs. O.C.

A92-45336

INTRODUCTION TO METAL MATRIX COMPOSITES AND A REVIEW OF THEIR POTENTIAL USES

D. DRIVER (Rolls-Royce, PLC, Derby, England) IN: Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990. Bristol, England/New York, IOP Publishing, Ltd./American Institute of Physics, 1991, p. 1-21. refs Copyright

The present development status evaluation for metal-matrix composite (MMC) applications in various aerospace and automotive component notes the character of these materials to be fundamentally related to their processing and fabrication conditions; applications' feasibility is often a direct function of the costs incurred by such manufacturing processes. More generally, MMCs combine the high ductility and relatively high formability/fabricability of metallic alloys with the higher strength and stiffness (at relatively low density) of ceramic particulates and fibers. Lighter, less expensive structural components are typically of SiC particle-reinforced Al alloys; Ti alloy-matrix alloys are found in more costly aerospace applications where continuous SiC fiber reinforcement is essential. O.C.

A92-45337

TEST REQUIREMENTS FOR METAL MATRIX COMPOSITES (MMC) IN AEROSPACE APPLICATIONS

N. J. SANDERS (British Aerospace, PLC, Materials and Development Dept., Preston, England) IN: Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990. Bristol, England/New York, IOP Publishing, Ltd./American Institute of Physics, 1991, p. 22-39. Copyright

The present assessment of the development status of aerospace MMC component test methods notes that a high degree of confidence exists for particulate- and whisker-reinforced composites' evaluation in both static and dynamic parameters' cases. The comparatively much smaller quantities of continuous fiber-reinforced MMC components that have thus far been produced have been characterized by component test methods to somewhat lower levels of confidence. Both static and dynamic property measurement development programs are required, and will have to cover both ambient and elevated temperatures. O.C.

A92-48611

MODELING AND COMPUTATION OF COMPOSITE MATERIALS

GEORGES DUVAUT (ONERA, Chatillon; Paris VI, Université, France) (NATO, AGARD, Structures and Materials Panel Meeting, 7th, Patras, Greece, May 24-29, 1992) ONERA, TP no. 1992-50, 1992, 6 p. refs (ONERA, TP NO. 1992-50)

The drawback of using composite materials in aeronautical and space engineering is the difficulty to predict their behavior and obtain valuable constitutive relationships to perform structure computations, due to the microscopic heterogeneities and the various phases and interfaces whose behavior is not well known. This paper proposes a homogenization method which makes it possible, when the microscopic structure can be assumed periodic at some intermediate scale, to build a constitutive relationship from the assumed knowledge of the behavior of the phases and interfaces of the composite. I.S.

A92-50007

ADDRESSING THE CHALLENGE OF AIRCRAFT COMPONENT DESIGN AND MANUFACTURE FROM METAL MATRIX COMPOSITES

D. CHARLES (British Aerospace /Commercial Aircraft/, Ltd., Bristol, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 206, no. G1, 1992, p. 1-13. refs Copyright

Recent developments in the use of metal matrix composites in the aerospace industry in the United States, Japan, and Europe are briefly reviewed, and the challenges posed by the design and manufacture of aerospace components from these materials are addressed with particular reference to programs carried out at British Aerospace. The objective of the programs was to develop low-cost manufacturing techniques and to demonstrate the potential of metal matrix composites by applying these techniques to the design, manufacture, and testing of representative aerospace structures. The activities related to mechanical property assessment, component fabrication technology, nondestructive testing, and design analysis are summarized. V.L.

A92-51563

AN INTEGRATED APPROACH TO DEVELOPING TOUGH EPOXIES

J. N. PRICE (BP Research Centre, Sunbury on Thames, England)
IN: International SAMPE Technical Conference, 23rd, Kiamesha Lake, NY, Oct. 21-24, 1991, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 959-968. refs

Copyright

Development of toughened epoxies is being backed by a wide range of scientific disciplines and associated research. This paper identifies the skills necessary to develop advanced matrix systems and highlights the areas of research necessary for further advances. It is concluded that there is an accepted move from developing new resin blends by 'trial and error' to designing in performance through understanding. The key areas that require further research are: (1) the chemical basis for toughness in polymers, (2) morphology/property interaction in resin blends, and (3) the relationship between neat resin properties and base laminate properties.

Author

A92-52982

HIGH TEMPERATURE MMCs FOR AERO-ENGINES - CHALLENGE AND POTENTIAL

W. WEI (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, Germany) Metals and Materials (ISSN 0266-7185), vol. 8, no. 8, Aug. 1992, p. 430-435. refs

Copyright

A nearly 200 C increase in service temperatures is projected for numerous innovative applications of metal-matrix composites (MMCs) to aircraft gas turbine compressor and hot-section components. The selection and optimization of material properties for a given application must be weighed against the difficulties and expense of the component's fabrication. Representative matrix materials are the Ti, Ni, and Co alloys; Al and Mg alloys can significantly reduce compressor low-pressure stage weights. Attention is given to the 'blade ring' or 'bling' MMC rotor stage structure and the mechanical property reductions associated with increasing angle between the load and fiber axis.

O.C.

N92-10068# Construcciones Aeronauticas S.A., Madrid (Spain). Subdirección de Investigación y Desarrollo de Tecnología y Materiales.

CORROSION TESTS OF MESHES IN CARBON FIBER LAMINATES: IMPACT BEAM TESTS [ENSAYO DE CORROSION DE MALLAS EN LAMINADOS DE FIBRA DE CARBONO PROBETAS DE IMPACTO AL RAYO]

1990 9 p In SPANISH

(INFORME-I-522/90; ETN-91-90059) Avail: CASI HC A02/MF A01

Corrosion resistance test results of copper alloy metal meshes, used in beam impact tests, are summarized. The use of a painting system is advised to avoid corrosion appearance in the metal meshes during an aircraft's service lifetime.

ESA

N92-12065# Aerospatiale, Paris (France).**NONDESTRUCTIVE TESTING OF OXIDATION PROTECTED CARBON/CARBON MATERIALS [LE CONTROLE NON DESTRUCTIF DES CARBONE/CARBONE PROTEGES CONTRE L'OXYDATION]**

PATRICE PLOTARD 1991 12 p In FRENCH

(REPT-911-430-136; ETN-91-90267) Avail: CASI HC A03/MF A01

The nose cone and attack edges of Hermes are submitted to temperatures up to 1800C during atmospheric reentry. Only oxidation protected carbon/carbon materials can resist such temperatures. The nondestructive tests described are intended to guarantee the structural strength of components and the resistance of the oxidation protection layer. The testing methods used are US, simulated IR thermography, Compton retrodiffusion and Foucault currents. A brief description of these test methods is presented.

ESA

N92-17310# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Hubschrauber und Flugzeuge.

RAPID REPAIR OF INTEGRALLY STIFFENED CARBON FIBRE COMPOSITE STRUCTURES BY BOLTED ALUMINIUM ELEMENTS

J. VILSMEIER and G. GUENTHER 22 May 1991 12 p (MBB-FE202-S-PUB-0453-A; ETN-92-90616) Copyright Avail: CASI HC A03/MF A01

Integrally stiffened carbon fiber composite structures, which are representative for dominantly shear and compression loaded skins of forward fuselages of modern fighter aircraft, are repaired using bolted aluminum elements. The design criteria for the repairs and the carbon fiber skin are described. The panels are tested for static and residual strength after spectrum fatigue loading. It is shown that the goal of recovering the ultimate design strength of the structure is achieved for both static and residual strength.

ESA

N92-18577# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).

FATIGUE LIFE BEHAVIOUR OF COMPOSITE STRUCTURES

W. BROECKER and K. WOITHE In AGARD, Fatigue Management 10 p Dec. 1991

Copyright Avail: CASI HC A02/MF A03

The general fatigue behavior of composite structures is presented. The verification and certification philosophy, depending on the special behavior of the material, is shown. On this basis a lot of structure tests were carried out, taking test parameters such as damages, environmental influence, and load conditions into consideration. The summary of these tests is presented.

Author

N92-21416# Construcciones Aeronauticas S.A., Madrid (Spain). Project Div.

APPLICATION OF EDDY CURRENT TECHNIQUES TO GRAPHITE COMPOSITE MATERIALS

M. ALVARO and V. CORTES 1991 9 p (ETN-92-90815) Avail: CASI HC A02/MF A01

Eddy current methods have been extensively applied in metals. The common characteristic for these applications is the high electrical conductivity of materials tested, higher than 1 pct. IACS (titanium). With the increasing use of graphite composite materials it is necessary to develop NDT (NonDestructive Test) methods for defects detection and materials characterization. The development of eddy current technique in composites is different to the usual ones for metals due to two features of CFRP (Carbon Fiber Reinforced Plastics); low electrical conductivity and intrinsic heterogeneity. Therefore the theory and practice differ greatly from conventional techniques. Theoretical models are more complicated than analogous in metals. In the technical aspect, special characteristics are required for probes and equipments. Applications include defectology and materials characterization. Experience collected during work performed in this field indicates that by means of an eddy current test it is feasible to reveal defects as cracks, impact damages, broken fibers, etc., and also to obtain information about fiber resin volume fraction and layup variations. Eddy current methods provide a complement to ultrasonic methods in the NDT of CFRP.

ESA

N92-21744# Rolls-Royce Ltd., Derby (England).**THE SEARCH FOR NEW MATERIALS**

S. C. MILLER 1 Oct. 1990 9 p (PNR-90777; ETN-92-90765) Copyright Avail: CASI HC A02/MF A01

The technology of advanced materials is considered and their great potential for improving the industry's operations is stressed. Their use in avionics, structural applications to airframes and in the aeroengine scene is considered. Families of materials and their development are traced and the 747-524 combination's performance as it could be improved by the materials which will become available in about 15 years time are considered.

ESA

24 COMPOSITE MATERIALS

N92-30414# Technische Univ., Delft (Netherlands).
LOW-VELOCITY IMPACT LOADING ON FIBRE REINFORCED ALUMINUM LAMINATES (ARALL) AND OTHER AIRCRAFT SHEET MATERIALS Ph.D. Thesis
ARIE VLOT 1991 577 p Sponsored by Netherlands Foundation for Technical Research
(ETN-92-91613) Avail: CASI HC A25/MF A06

The impact properties of new aircraft materials play an important role for the design and certification of aircraft structures. Low velocity impact tests were carried out on monolithic aluminum alloys, various types of Arall laminates and thermoplastic composites. The damage resistance, the image tolerance (residual strength after impact damage) and residual strength of the various materials are compared. In the literature only dynamic linear elastic models and a static nonlinear elastic model are available. A Non Linear Elastic Impact Model (NOLEIM) was developed, which is able to calculate the force time, velocity time and deflection time curves accurately. The calculations of this model were compared with experimental and finite element results. A static Elasto Plastic Impact Model (EPIM) was derived which is able to calculate deflection energy and force deflection curves. ESA

N92-33033# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

THE UTILIZATION OF ADVANCED COMPOSITES IN MILITARY AIRCRAFT [L'EMPLOI DES MATERIAUX COMPOSITES DE POINTE POUR LES AVIONS MILITAIRES]

Apr. 1992 194 p In ENGLISH and FRENCH The 73rd meeting was held in San Diego, CA, 7-11 Oct. 1991 (AGARD-R-785; ISBN-92-835-0666-9; AD-A253004) Copyright Avail: CASI HC A09/MF A03

The purpose of this workshop was to identify the current state of the art in key issues related to compression loading and fluid effects in composite materials. In the area of compression loading, there was considerable concern over the different results obtained from various test methods. It was agreed that failure modes produced by the various test methods along with a better fundamental understanding of compression failure were key issues in the development of compression test methods. In the area of fluid effects, a lack of a comprehensive data base hampers identification of key mechanisms leading to fluid degradation. This is further complicated by the fact that interactions depend on the fluid and composite under consideration.

N92-33036# British Aerospace Aircraft Group, Warton (England). Materials and Development Dept.

ASPECTS OF COMPRESSION IN AEROSPACE COMPOSITES: FUTURE REQUIREMENTS

STUART GREEN In AGARD, The Utilization of Advanced Composites in Military Aircraft 13 p Apr. 1992
Copyright Avail: CASI HC A03/MF A03

To keep the overall mass of combat aircraft to a minimum level, and to optimize performance, designers have exploited the benefits offered by advanced polymer composite materials. The ability to resist load in compression is, however, particularly important in some aircraft structures such as wings. Advantages in terms of reduced mass and increased performance to be gained with composite materials is highlighted in this paper. A general overview is given of the materials science aspects of compression and compression after impact. Recent developments aimed at improving the reliability of compression test data is reviewed.

Author

N92-33043# Dassault-Breguet Aviation, Saint Cloud (France). INNOVATIVE CONSTITUENTS REQUIREMENTS TO IMPROVE COMPOSITES COMPRESSIVE STRENGTH

L. ANQUEZ and P. VAUTEY In AGARD, The Utilization of Advanced Composites in Military Aircraft 10 p Apr. 1992
Copyright Avail: CASI HC A02/MF A03

While the recent development of intermediate modulus carbon fibers led to very high specific tensile strength over the first generation of high strength composites, the composite compressive

properties did not improve at all. Because most aeronautical structures are subject to alternate tension and compression, it is not possible to take full advantage of carbon fiber composites, as the compressive loading becomes the design limitation. After a focus on the matrix dominating role in composite compression behavior, this paper will clear out which matrix characteristics, stiffness or strength, determines the unidirectional compressive failure. H.A.

N92-33044# Alenia, Foggia (Italy). Engineering Dept. for Advanced Composite Structures.

CFRP STIFFENED PANELS UNDER COMPRESSION

A. BUCCI and U. MERCURIO In AGARD, The Utilization of Advanced Composites in Military Aircraft 14 p Apr. 1992
Copyright Avail: CASI HC A03/MF A03

The purpose was to experimentally demonstrate the validity of the conceptual carbon fiber reinforced plastics (CFRP) stiffened panel suitable for application in the unpressurized aft fuselage of a middle size aircraft. Both theoretical and experimental behavior have been analyzed taking into account the effects of different materials, curvature, impact damage, and static and fatigue loads. Composite materials with stiff fibers of the last generation coupled with toughened thermosetting resin systems were used. Author

N92-33048# Centre d'Essais Aeronautique Toulouse (France). EVALUATION OF THE EFFECTS OF THE ENVIRONMENT ON THE BEHAVIOR OF THE PRIMARY STRUCTURES OF COMPOSITE MATERIAL AIRCRAFT IN SERVICE: HISTORIC AND CURRENT SITUATION [PRISE EN COMPTE DES EFFETS DE L'ENVIRONNEMENT SUR LE COMPORTEMENT EN SERVICE DES STRUCTURES PRIMAIRES D'AVIONS EN MATERIAU COMPOSITE: HISTORIQUE ET SITUATION ACTUELLE]

JEAN ROUCHON In AGARD, The Utilization of Advanced Composites in Military Aircraft 7 p Apr. 1992 In FRENCH
Copyright Avail: CASI HC A02/MF A03

When the first application of composite materials with an organic base in the working structures of aircraft were envisaged, the greatest preoccupation of the designers and service officials was their behavior while aging. Some fifteen years later, the experience acquired in service associated with the numerous results obtained from the laboratory has greatly dissipated those fears, at least for structures not calling for extensive usage of composite technology. This does not mean that the aging of composites does not occur, but rather that the consequences are now considered to have limited and predictable impact. In other words, they are susceptible to being accounted for at the level of conception, certification, and thereafter in use in the structures. The principal steps leading to the current situation are retraced, and then analyzed to account for the phenomena of aging, in particular the determination of the concentration of water absorbed by the composite during use.

Transl.

N92-33053# Alenia, Foggia (Italy). ENVIRONMENTAL RESISTANCE OF AMORPHOUS BONDED THERMOPLASTIC JOINTS

C. VOTO and M. IANNONE In AGARD, The Utilization of Advanced Composites in Military Aircraft 5 p Apr. 1992
Copyright Avail: CASI HC A01/MF A03

Amorphous bonding appears to be a promising method of joining thermoplastic matrix advanced composites. The temperature to bond, lower than for fusion bonding, and the limited dimension of the melted zone, allow significant cost reduction and guarantee good mechanical characteristics. On the other hand, a potential problem exists, due to lower resistance to aeronautical solvents and service fluids, because of the amorphous nature of the bonding layers. The basic resistance to environmental degradation of the resins used for bonding, and the chemical stability of their blends with the semicrystalline matrices of the adherends, have been investigated. Author

INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

A92-14020**GRAVITATIONAL EFFECTS ON FLAME SPREADING OVER THIN CYLINDRICAL FUEL SAMPLES**

J. J. SALVA (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) and G. L. JUSTE (Microgravity Science and Technology (ISSN 0938-0108), vol. 4, Oct. 1991, p. 191-198. refs

(Contract ESA-8272/89/F/BZ(SC))

Copyright

Some of the experimental work performed on burning thin cylindrical fuel samples at reduced gravity in an aircraft laboratory and on ground is presented. The fuel samples used were PMMA rods 1.5-2.5 mm in diameter and tubes 0.1-0.25 mm thick and 4 mm in diameter. The results show that the flame-spreading velocity, for a Damkoehler number much greater than 1, increases as gravity level is reduced, due to geometrical enhancing heat flux effects of nonplanar flame.

Author

A92-20344**DIRECT SIMULATION AND MODELING OF PREMIXED TURBULENT COMBUSTION [SIMULATION DIRECTE ET MODELISATION DE LA COMBUSTION TURBULENTE PREMELANGEE]**

THIERRY POINSOT (CNRS; Ecole Centrale des Arts et Manufactures, Chatenay-Malabry, France) *Revue Scientifique et Technique de la Defense* (ISSN 0994-1541), 2nd Quarter, 1991, p. 17-21. In French. refs

Copyright

The paper describes how direct numerical simulations of flame/vortex interactions or of flames interacting with turbulence may be used to improve models for turbulent combustion. The numerical formulation includes nonunity Lewis number, nonconstant viscosity, and heat losses, so that the effects of stretch, curvature, transient dynamics, and viscous dissipation can be accounted for. As a result, flame quenching by vortices (which is one of the key-processes in premixed turbulent combustion) may be computed accurately. Models for turbulent combustion in piston engines or aircraft propulsion systems may also be improved on the basis of these results.

Author

A92-25475**INTERACTION OF A FLAME FRONT WITH ITS SELF-GENERATED FLOW IN AN ENCLOSURE - THE 'TULIP FLAME' PHENOMENON**

M. GONZALEZ, R. BORGHI, and A. SAOUAB (Rouen, Universite, Mont-Saint-Aignan, France) *Combustion and Flame* (ISSN 0010-2180), vol. 88, Feb. 1992, p. 201-220. refs

Copyright

The propagation of a flame front under nonturbulent condition in a closed tube ignited at one end is numerically investigated using a computing procedure based on finite volumes technique and devoted to 2D compressible reacting flows. A global one-step reaction for the chemical process and an Arrhenius law for fuel consumption are assumed. The detailed analysis of the results of computations in which wall friction, tube aspect ratio, and initial flame configuration are varied makes it possible to highlight the influence of different parameters and to get more insight into the tulip-shaped flame phenomenon. In particular, Darrieus-Landau instability is examined by comparing the shape variations of an initially perturbed flat front in a tube closed at both ends to those in a tube in which the ignition end is open while the opposite one is closed. Attention is also given to the computed flame generated flowfield; the flame front-confined flow interaction is specially scrutinized. The oscillatory acoustic regime occurring during tulip

flame appearance, as well as the collapse of the tulip shape in tubes of large aspect ratio were simulated and discussed.

Author

A92-49017#**COMBUSTION CALCULATIONS ON A PREMIXED SYSTEM WITH A BLUFF BODY FLAMEHOLDER**

S. OLOVSSON (Volvo Flygmotor, AB, Trollhattan, Sweden) *AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit*, 28th, Nashville, TN, July 6-8, 1992. 9 p. Research supported by STU, Swedish Defence Materiel Department, Volvo Research Foundation, et al. refs

(AIAA PAPER 92-3470) Copyright

Numerical simulations of a premixed propane-air flame using a standard finite difference code has been performed on a geometry with two different bluff body flameholders in a straight channel. Calculated results are compared with gas analysis data and velocities measured with LDA, and it is found that the code used with a standard k-epsilon model has difficulties in predicting the correct values. This is due to an underprediction of the generated turbulence intensity in the shear layer which leads to a slow mixing process in the calculations. The paper also discusses the possibility of using a two-step global model for calculations near stoichiometric conditions and on the fuel-rich side. It is shown that a two-step model is not sufficient for equivalence ratios above around 0.85.

Author

N92-14141# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physics.

APPLICATIONS OF ULTRA-HIGH VACUUM TECHNIQUE TO SURFACE AND NEAR-SURFACE STUDIES Ph.D. Thesis

JOUKO LAHTINEN 1990 24 p Sponsored by Finnish Technology Development Center

(ETN-92-90454) Avail: CASI HC A03/MF A01

The construction and characteristics of two multifunctional Ultra High Vacuum (UHV) systems is reported. The first system is a slow positron beam apparatus for surface and near surface studies equipped with surface sensitive Auger Electron Spectroscopy (AES) and Low Electron Electron Diffraction (LEED) techniques. The system was applied to study defects induced by hydrogen implantation in silicon. The second system is a combined UHV atmospheric pressure apparatus designed for catalytic surface studies. The apparatus is equipped with X-ray photoelectron spectroscopy, thermal desorption spectroscopy, AES and LEED together with an atmospheric pressure cell within the UHV chamber for reaction experiments. This apparatus was used to study the effect of MgO on CO adsorption on Co(0001). The effect of TiO₂ coverage on hydrogenation of the C-O bond on Rh foil was studied with similar equipment.

ESA

N92-27486# Centre National de la Recherche Scientifique, Chatenay-Malabry (France).

THE COHERENT FLAMELET MODEL FOR PROPULSION APPLICATIONS

D. VEYNANTE (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France).), F. LACAS (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France).), P. BOUDIER (Institut Francais de Petrole, Grenoble.), B. DILLIES (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France).), J. M. SAMANIEGO (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France).), T. POINSOT (Centre National de la Recherche Scientifique, Annecy-le-Vieux (France).), and S. CANDEL *In AGARD, CFD Techniques for Propulsion Applications* 14 p Feb. 1992 Sponsored in part by SNECMA and DRET

Copyright Avail: CASI HC A03/MF A06

This article reports our recent progress in the modeling of turbulent combustion for propulsion applications. The description of the reactive flow relies on the flamelet concept and uses a transport equation for the flame surface density. The coherent flamelet description which has evolved from a series of numerical and experimental studies is first reviewed and its recent improvements are explained. We then focus on the premixed version of the model. Two applications of relevance to aeronautical

propulsion are then described. The first concerns a flame stabilized by a hot stream of combustion products. The second deals with a ramjet configuration comprising two lateral injection jets. In both cases, the model predictions are compared with experiments. It is shown that the model provides viable representations of these two cases. Author

N92-31942# European Space Agency, Paris (France).
CONTRIBUTION TO THE MODELLING OF TURBULENT COMBUSTION IN THE CASE OF STABILISATION BY FLAME-LOCK [CONTRIBUTION A LA MODELISATION DE LA COMBUSTION TURBULENTE DANS LE CAS D'UNE STABILISATION PAR ACCROCHE-FLAMMES]

PASCALE GILBANK (Office National d'Etudes et de Recherches Aérospatiales, Paris, France) Nov. 1991 208 p. Transl. into ENGLISH of French document (Paris, France, ONERA), 1989 Original language document was announced as N91-11090 (ESA-TT-1229; ONERA-NT-1989-8; ETN-92-91387) Avail: CASI HC A10/MF A03

A method for predicting turbulent reactive flows, capable of describing various combustion regimes and of being adapted to realistic reactive schemes, is suggested. In industrial configurations such as the afterburning combustors of aircraft engines, various turbulent combustion regimes can coexist at various locations of the combustor or at various times. The chemical kinetics in these flows are complex and it can be important to predict the variation of the various species involved, both intermediate species which determine the overall reaction rate, and the production of contaminating species. The particular feature of this method, called the PEUL model, is the use of Eulerian balance equations to describe the variation of the variables characterizing the flow; the source term involved in the Eulerian balance equations for the mass fractions of the chemical species is determined by Lagrangian equations. The Lagrangian approach has the advantage of describing the flow from a more phenomenological standpoint. The PEUL model thus allows numerical prediction of multireactive turbulent flows. The PEUL model is applied to a turbulent air/methane premixing flame developing in a two dimensional channel with constant section or in a channel possessing a step behind which a recirculation zone is established. ESA

26

METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

A92-15202
HIGH TEMPERATURE MULTIAXIAL CREEP TESTING OF NIMONIC 115

L. W. CANDLER (Royal Aerospace Establishment, Farnborough, England) IN: Creep and fracture of engineering materials and structures; Proceedings of the 4th International Conference, Swansea, Wales, Apr. 1-6, 1990. London, Institute of Metals, 1990, p. 843-851. refs Copyright

A high-temperature multiaxial testing facility commissioned using the nickel-base alloy Nimonic 115 is presented and the difficulties associated with this technique for testing are highlighted. This prototype testing machine was commissioned such that a variety of test conditions could be performed in axial, torsional, or multiaxial loading modes, at elevated temperatures (up to 1000 C). Ideas for a suitable specimen were taken from the design stage, developed and tested under a number of conditions. The limiting factors of the design are emphasized and hence modifications can be made to the initial design in order to develop the specimen design for use in future test programs. A technique developed for performing the actual tests is presented. The applicability of the Von Mises approach is discussed. C.A.B.

A92-15244
CORROSION DAMAGE AND REGENERATION OF ALUMINIDE COATINGS ON AIRCRAFT TURBINE BLADES

L. SWADZBA, B. FORMANEK, and A. MACIEJNY (Silesian Technical University, Katowice, Poland) IN: High temperature corrosion 2 - Advanced materials and coatings. London and New York, Elsevier Science Publishers, 1989, p. 407-412. refs Copyright

Microanalytical investigations have been conducted on the alloying-element distributions of corrosion-induced microstructure changes during successive stages of damage in the protective layers of Ni-base alloys. While increased Cr and S contents are noted in the corrosion attack zone, the Mo-, W-, and Cr-enriched diffusion-zone microstructure remains virtually unchanged. Attention is presently given to two turbine blade airfoil-recoating methods: CVD chromoalumination, and diffused annealing of a sprayed-on silicoaluminizing suspension. Such regeneration can regain turbine blade properties after a period of service. The criteria of surface-quality assessment and verification of the blades in successive regeneration stages are presented. O.C.

A92-19767
CRACK INITIATION AND THE SHORT-TO-LONG CRACK GROWTH TRANSITION IN A NI-BASE SUPERALLOY

J. E. KING (Cambridge, University, England) and A. D. BOYD-LEE IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1205-1210. Research supported by Rolls-Royce, PLC and British Gas, PLC. refs Copyright

A study has been made of the initiation and early fatigue crack growth of 58 cracks in AP1 (Astroloy) with a necklace microstructure at 20 C under loading with a maximum stress equal to 0.8 of the yield stress and $R = 0.1$. Clear statistical trends observed in the microstructural conditions favoring initiation and the path taken by these cracks through the surface grains of the specimen are presented. Author

A92-19796
HIGH TEMPERATURE LOW CYCLE FATIGUE OF SINGLE CRYSTAL NICKEL BASE SUPERALLOYS

M. MARCHIONNI, E. PICCO, D. RANUCCI (CNR, Istituto per la Tecnologia dei Materiali Metallici non Tradizionali, Cinisello Balsamo, Italy), and V. CATENA (Fiat Aviazione S.p.A., Turin, Italy) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 3. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1735-1740. refs Copyright

The low-cycle fatigue behavior of three different single crystal nickel base superalloys (one with high density and two with low density) is analyzed in the temperature range 600-1000 C. The fatigue life of single crystal alloys is sensibly higher than that of other cast of directionally solidified nickel base alloys due to the presence of a low plastic strain component in the hysteresis loop. The fatigue results are discussed, taking into account the anisotropy of the alloys and their density. Author

A92-22760
THE BETA-CEZ - A HIGH PERFORMANCE TITANIUM ALLOY FOR AEROSPACE ENGINES

B. PRANDI, J. F. WADIER (Compagnie Européenne du Zirconium, Centre de Recherches, Ugine, France), F. SCHWARTZ, P. E. MOSSER (SNECMA, Gennevilliers, France), and A. VASSEL (ONERA, Chatillon, France) IN: Titanium 1990: Products and applications; Proceedings of the International Conference, Buena Vista, FL, Sept. 30-Oct. 3, 1990. Vol. 1. Dayton, OH, Titanium Development Association, 1990, p. 150-159. Research supported by Service Technique des Programmes Aeronautiques. refs Copyright

Beta-CEZ, a Ti-base (Ti-5Al-2Sn-4Zr-4Mo-2Cr-1Fe) alloy with

high tensile strength and toughness as well as excellent creep resistance in service temperatures of as much as 450 C, has been developed with a view to such medium-high temperature applications as aircraft gas turbine compressor disks. Beta-CEZ ingots are forged in the beta-field between 1050 and 1100 C; a second transformation occurs in the alpha-beta field, which occurs in the vicinity of 850 C. An account is given of thermomechanical treatment results. O.C.

A92-25026

A STUDY OF REVERSION BEHAVIOUR IN 8090 ALLOYS USING SMALL ANGLE NEUTRON SCATTERING AND TRANSMISSION ELECTRON MICROSCOPY

P. D. PITCHER (Royal Aerospace Establishment, Farnborough, England), R. J. STEWART, and S. GUPTA (Reading, University, England) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Feb. 15, 1992, p. 511-516. refs

Copyright

The distribution of delta prime precipitates in 8090 alloys was investigated by small angle neutron scattering and transmission electron microscopy before and after reversion aging. It is found that the number of the smallest scattering sites (delta prime precipitates or their precursors) is significantly reduced by the reversion aging, with a reduction in the volume fraction of delta prime precipitates. This is thought to be responsible for the large increase in toughness observed after reversion aging. A gradual decay of the gain in toughness occurs, however, due to the reformation of fine delta prime precipitates during further low-temperature or natural aging. V.L.

A92-26128

MA ALLOYS FOR AEROSPACE APPLICATIONS

I. C. ELLIOTT and G. A. J. HACK (Inco Alloys International, Ltd., Hereford, UK) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 15-24. refs

Copyright

Of all the metallurgical process developments which have taken place in recent decades, mechanical alloying (MA) ranks among the most novel in its ability to alloy powder in the solid state and avoid the many problems of melting and solidification in complex alloys. A series of MA, oxide-dispersion-strengthened Fe-Cr, Ni-Cr and Ni-Cr-gamma prime alloys has been developed which exhibit very high elevated temperature strength, and in some cases also remarkable oxidation resistance. Their applications in aircraft engine blade, vane and sheet components are described. Whereas the current alloys are aimed largely at direct replacements of existing superalloys, the future exploitation of MA will be in alloys and alloy systems which are very difficult or impossible to produce by any other means. Author

A92-47958

INVESTIGATION OF THE STRUCTURAL INHOMOGENEITY OF A TITANIUM ALLOY [ISSLEDOVANIE STRUKTURNOI NEODNORODNOSTI TITANOGO SPLAVA]

D. V. IORDANOV, N. D. GIZDOVA, I. U. M. SIMEONOVA (Bulgarian Academy of Sciences, Space Research Institute, Stara Zagora, Bulgaria), and A. V. SHOPOV (Institut Mikroelektroniki, Sofia, Bulgaria) B'lgarska Akademiia na Naukite, Dokladi (ISSN 0366-8681), vol. 44, no. 10, 1991, p. 23-25. In Russian. refs

Copyright

Inspection of an aircraft engine indicated small cracks of a peculiar type on the titanium ring of the compressor. These cracks were located in a relatively unloaded region; however, under the effect of vibration they could lead to the formation of a 'closed circuit' and to separation of part of the body with subsequent fracture of the compressor. Auger spectroscopy and secondary ion mass spectroscopy were used to analyze the region of ring fracture due to such small cracks. The crack formation was found to be associated with an unusual increase in carbon content in the depthwise direction in the fracture region. This increase may

be due to the processing of the material at the metallurgical stage. L.M.

A92-48578

ADVANCED SUPERALLOYS FOR TURBINE BLADE AND VANE APPLICATIONS

T. KHAN and P. CARON (ONERA, Chatillon, France). (Canadian Institute of Mining and Metallurgy, Symposium on Advances in Gas Turbine Engine Materials, Ottawa, Canada, Aug. 19, 20, 1991) ONERA, TP no. 1992-2, 1992, 19 p. refs

(ONERA, TP NO. 1992-2)

Recent developments in single crystal superalloys and their mechanical properties are reviewed. These alloys make it possible to attain turbine inlet temperatures of about 1600 C and a metal temperature in excess of 1100 C. New compositions and improved processing routes are being developed for large directionally solidified and single crystal blades and vanes for applications in industrial gas turbines. The SC 16 superalloy provides a temperature advantage of about 50 C over the IN 738 superalloy along with an excellent corrosion resistance. The MC2 alloy has a very high strength and a temperature capability of greater than 1100 C. AM1 is now being used in the M88 SNECMA engine for the RAFALE fighter plane. Attention is also given to micromechanical models which take into account active slip systems and further progress in NiAl-based intermetallics. O.G.

A92-48610

ALUMINIDES MODIFIED BY PALLADIUM - PROTECTION OF NEW PARTS BY LOCAL FINISHING [ALUMINIURES MODIFIES PAR LE PALLADIUM - DE LA PROTECTION DES PIECES NEUVES A LA RETOUCHE LOCALE]

P. JOSSO, S. ALPERINE (ONERA, Chatillon, France), and P. STEINMETZ (Nancy I, Universite, Vandoeuvre, France) (Surfact IX, Cannes, France, June 3-5, 1992) ONERA, TP no. 1992-49, 1992, 21 p. In French. refs

(ONERA, TP NO. 1992-49)

On hot section parts of aircraft turbines consisting of nickel-base superalloys, aluminides modified by platinum have shown high resistance to heat corrosion and high temperature oxidation. Nevertheless, economic considerations have encouraged research with palladium for a less costly replacement metal modifier. The simplicity of implementing an electrolytic coating of palladium-nickel has allowed the development of a 'buffer' coating technique. R.E.P.

A92-52983

STEELS FOR AEROSPACE APPLICATIONS

H. EVERSON (Stockbridge Engineering Steels, Sheffield, United Kingdom) Metals and Materials (ISSN 0266-7185), vol. 8, no. 8, Aug. 1992, p. 440, 441.

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Although the percentage of steel components in military and other high-performance aircraft has steadily declined over the past 20 years, steel continues to be the material of choice for landing-gear components. Such high-strength landing gear steels as VAR 4340 Mod and 35 NCD16 have limited defect sizes that are readily detected by such NDT techniques as immersion ultrasonic examination. The high corrosion resistance of these steels is as yet not easily duplicated in alternative materials and composites, which also pose inspection-related difficulties. O.C.

N92-20911# Rolls-Royce Ltd., Derby (England).

HIGH TEMPERATURE PROCESSING AND DEFORMATION OF A NEAR-ALPHA TITANIUM ALLOY

S. G. MCKENZIE and N. A. WALKER 1 Dec. 1990 38 p Presented at Aeronat 1990

(PNR-90853; ETN-92-90801) Copyright Avail: CASI HC A03/MF A01

The need for lighter weight and more efficient gas turbine engines has resulted in the development of several advanced near alpha titanium alloys with successive improvements in temperature capability. The latest in this line is IMI 834 which offers improved tensile and creep strength compared with other

established creep resistance alloys such as IMI 685 and IMI 829. The hot deformation characteristics of IMI 834 are looked at. The effects of deformation on microstructure are reported along with the influence of subsequent heat treatment to produce the optimum balance of mechanical properties throughout the disc forging. The effect on mechanical properties is discussed and correlated to the microstructure using transmission electron microscopy. ESA

N92-29647# Napier Coll., Edinburgh (Scotland).
DYNAMIC SOLDER MANAGEMENT Interim Report, Dec. 1991 - Feb. 1992

M. CUMMINGS and G. LINDSAY Feb. 1992 13 p
Contract DAJA45-91-C-0016
(AD-A250564; R/D-6750-MS-01) Avail: CASI HC A03/MF A01

Results from initial 2D steady-state isothermal simulations of wave soldering of DSM modified PCBs are presented. The effects of small (2mm) obstacles on solder flow paths can be clearly seen. More sophisticated, realistic models are under development and will be reported next quarter. GRA

N92-32895# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Metals Lab.

NEW ACCELERATED CORROSION TEST METHODS

URSULA KOCH and THEODOR HACK 1991 5 p Presented at BRITE-EURAM Aeronautics Days, Brussels, Belgium, 16-17 Apr. 1991 Submitted for publication
(MBB-Z-0406-91-PUB; ETN-92-92123) Avail: CASI HC A01/MF A01

A project which established accelerated corrosion test methods for conventional Al and new AlLi alloys and surface protection schemes is described. New accelerated testing methods will allow the selection of material and protection schemes with increased resistance to corrosion. The aim is to improve the corrosion performance of modern European aircraft. The objectives are the following: detection of general corrosion and stress corrosion cracking at a very early stage by means of electrochemical monitoring; development of accelerated corrosion tests which can reliably simulate service conditions; assessment of the corrosive environment in an aircraft by installation of sensors and in situ corrosion monitoring; clarification of the role of hydrogen on stress corrosion mechanism of Al alloys; determination of the influence of microorganisms on corrosion failure; and simulation of microbiological induced corrosion for material qualification purposes. Achievements to date and potential applications of the results are discussed. ESA

N92-70307 National Aerospace Lab., Amsterdam (Netherlands).
DAMAGE TOLERANCE AND DURABILITY EVALUATION OF ALUMINUM-LITHIUM ALLOYS

R. J. H. WANHILL, L. SCHRA, and W. G. J. THART 19 Jan. 1989 11 p Presented at the International Conference Evolution of Advanced Materials, Milan (Italy), May - Jun. 1989 (PB91-219477; NLR-TP-89021-U; AD-B155447L) Avail: CASI HC A03/MF A01

New impetus to continued use of aluminum alloys in major structural areas of aircraft has been given by the development of aluminum-lithium alloys. However, qualification of these new materials for service requires extensive testing and evaluation, preferably in international cooperative programs. The evaluation of aluminum-lithium alloys is discussed with particular attention to the balance of properties required to achieve damage tolerant and durable, long-life structures for transport aircraft. An assessment of the current developmental maturity of damage tolerant aluminum-lithium alloys is given. GRA

NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

A92-20393

ATOMIC OXYGEN PROTECTION OF CARBON AND POLYCARBONATE USING BORON CARBIDE COATING

BRUCE M. SWINYARD (Rutherford Appleton Laboratory, Didcot, England) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 28, Nov.-Dec. 1991, p. 730-732. refs
Copyright

Measurements have been obtained of the effects of atomic oxygen erosion on polycarbonate/carbon composite optical filters and the behavior of protective coatings for the filters. Attention was given to the novel application of boron carbide as a protective coating against atomic oxygen erosion; a 1000-A layer of boron carbide is found to be capable of furnishing virtually complete protection against erosion. O.C.

A92-25615

MECHANICAL PROPERTIES AND FRACTURE BEHAVIOUR OF POLYIMIDE (SINTIMID) AT CRYOGENIC TEMPERATURES

E. TSCHEGG (Wien, Technische Universitaet, Vienna, Austria), K. HUMER, and H. W. WEBER (Atominstut der Oesterreichischen Universitaeten, Vienna, Austria) Cryogenics (ISSN 0011-2275), vol. 31, Oct. 1991, p. 878-883. Research supported by BMFWF. refs

Copyright

In view of emerging applications in aeronautics, low temperature and nuclear fusion technology, the mechanical properties of plastics have to be tested both at cryogenic temperatures and under certain radiation environments. Measurements are reported of the elastic modulus, the ultimate tensile strength (UTS) and the failure strain of a polyimide (SINTIMID), which were carried out at room temperature, 77 and 4.2 K. In addition to this temperature dependence, the influence of sample size on the mechanical properties, as well as the fracture behavior in mode I on cylindrical precracked samples with a circumferential notch, have been investigated. The results show an increase in both the elastic modulus and the UTS by 40 and 60 percent, respectively, on decreasing the temperature to 77 K, but no further change at lower temperatures. On the other hand, the failure strain decreases continuously (by about 25 percent) down to 4.2 K, while the fracture toughness increases in a similar way (by about 10 percent). No sample size dependence could be detected. These results are discussed in conjunction with additional observations of the fracture behavior made using optical and scanning electron microscopes.

Author

A92-36292

CHARACTERIZATION BY XPS AND SEM OF REACTIVE CHEMICAL VAPOUR DEPOSITED BORON CARBIDE ON CARBON FIBRE

C. VINCENT, H. VINCENT, H. MOURICHOUX, and J. BOUIX (Lyon I, Universite, Villeurbanne, France) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 7, April 1, 1992, p. 1892-1900. Research supported by DRET. refs

Copyright

A process and apparatus used in the large-scale deposition of boron-based films on carbon fibers is described. The deposition occurs when the heated moving fibers react with a BCl₃-H₂ mixture. Among other advantages, such a process provides for continuous processing at atmospheric pressure. The properties of the as-deposited fibers are discussed in terms of their use in material composites under ambient atmosphere. X-ray photoelectron spectroscopy shows that the filament surface consists of a B₄C-BN mixture.

Author

N92-18479# Technische Univ., Eindhoven (Netherlands).

A NOVEL ROUTE TO BLENDS OF POLYSTYRENE AND POLY(2,6-DIMETHYL-1,4-PHENYLENE ETHER): SYNTHESIS, PROPERTIES, AND APPLICATIONS Ph.D. Thesis

LAURENTIUS NICOLAAS NELISSEN 1991 158 p Sponsored by Bredase Polystyreen Maatschappij B.V. (ETN-92-90578) Avail: CASI HC A08/MF A02

A method for preparing the chemical blend Polystyrene (PS)/Poly(2,6-dimethyl-1,4-Phenylene Ether) (PPE) is described. For the preparation of polymer beads via a free radical initiated suspension polymerization, PPE has to be endcapped in order to avoid the inhibiting effect on the styrene polymerization. A 'cold' endcapping method, to modify PPE under mild conditions in styrene without further purification and isolation of PPE, is presented. Related modification reactions of PPE using various end groups, which can be used for purposes such as (block) copolymerization, are described. Several low polar mass model compounds were synthesized to gain a better understanding of the inhibiting effect from the terminal 2,6-xylenol group of PPE. The phase behavior of the miscible PS/PPE blend was studied as a function of pressure. Compression or injection molding of the blend results in a two phase and multiple phase separated blend respectively. As a consequence of the phase separation phenomenon under pressure, conventional processing of PS/PPE-Ac blends is not feasible. The application of the system for preparing high Tg PS foams is described. ESA

N92-24829*# Centre National d'Etudes Spatiales, Toulouse (France).

SPACECRAFT THERMAL CONTROL COATINGS

JEAN-CLAUDE GUILLAUMON (Centre National d'Etudes Spatiales, Toulouse (France).) and ALAIN PAILLOUS (Centre d'Etudes et de Recherches, Toulouse, France) /n NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 p 945-960 Jan. 1992

The Experiment AO 138-6 was located on the trailing edge of the Long Duration Exposure Facility as part of the French Cooperative Payload (FRECOPA) Experiment. It was purely passive in nature: material specimens 2 x 2 cm, independently mounted in sample-holders, with their surface in the same reference plane, were exposed to space. Thirty samples were set in a vacuum-tight canister which was opened in space a few days after LDEF deployment and closed while still in orbit ten months later; twenty-four samples were directly exposed to space for the total flight duration (preflight handling, shuttle bay environment, separation from shuttle, shuttle environment, LEO environment, docking, descent, transfer to KSC). Materials included paints (conductive or nonconductive), SSM's, polymeric films, surface coatings, composite materials, and metals. After sample retrieving, inspection and measurements were carried out in atmospheric laboratory conditions on each sample: observation with binocular lenses and scanning electron microscopy, spectral reflectance and transmittance using an integrating sphere in the wavelength range 280-2300 nm, emissivity by the means of a Gier & Dunkle portable reflectometer, electron spectroscopy for chemical analysis-x-ray photoelectron spectroscopy (ESCA-XPS), and Rutherford backscattering spectroscopy (RBS) measurements on some selected samples. The results obtained from flight were compared to laboratory data obtained in UV-irradiation tests when these data were available. As a general statement a good spectral concordance is observed for all samples not in the canister so long as air recoveries are taken into account. For one material, the degradation is more important for the sample in the canister than for those of the same material mounted at the surface of the tray; for most samples in the canister the degradation is slightly higher than the one which can be predicted from laboratory standard irradiations. Contamination problems having been ruled out, the higher temperature experience by the samples on the inside of canister probably explains these phenomena. Author

N92-27300*# Centre National d'Etudes Spatiales, Toulouse (France).

SPACECRAFT THERMAL CONTROL COATINGS: COMPARISON BETWEEN FLIGHT RESULTS OBTAINED ON LDEF AND MIR Abstract Only

JEAN-CLAUDE GUILLAUMON (Centre National d'Etudes Spatiales, Toulouse (France).) and A. PAILLOUS (Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse, France) /n NASA. Langley Research Center, Second LDEF Post-Retrieval Symposium Abstracts p 94 Jun. 1992

Avail: CASI HC A01/MF A02

The COMES experiment was installed outside of the MIR space station during an extravehicular activity. The experiment was exposed to vacuum, atomic oxygen, and ultraviolet radiation (UV) for 1.1 years. Due to a lack of knowledge about the spacecrafts actual attitude, there is a large uncertainty in the atomic oxygen fluence and the UV dose that was experienced by COMES. Additionally, contaminants of many different origins were observed on the COMES samples. Author

28

PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

A92-43467

NUMERICAL COMPUTATIONS OF SOLID-PROPELLANT NONSTEADY BURNING IN OPEN OR CONFINED VOLUMES

L. GALFETTI (Milano, Politecnico, Milan, Italy), G. RIVA (CNR, Milan, Italy), and C. BRUNO (Roma I, Universita, Rome, Italy) /n: Nonsteady burning and combustion stability of solid propellants. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1992, p. 643-687. refs Copyright

Mathematical models and numerical techniques are presented that can be used to simulate steady states and continuous transients of solid propellants. A semiinfinite condensed phase and a reference frame fixed to the burning surface are assumed. Experimental verification of the analysis and the nonlinear frequency responses is conducted for different thermophysical characteristics. Aluminum-perchlorate-based propellants are shown to have a nonlinear temperature dependence of the composite-propellant thermal conductivity. A two-step consecutive mechanism is developed for the super-rate burning of double-base propellants demonstrating the effects on intrinsic combustion stability and dynamic stability of partitioning heat release into two parts. Data regarding dynamic combustion and unburned layer thicknesses are also given to account for the the propellants' finite-thickness effects. C.C.S.

29

MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

A92-57307

CRYSTAL GROWTH EXPERIMENTS ON RUSSIAN UNMANNED SPACECRAFT

P. HOFMANN, R. KLETT, P. SICKINGER (Kayser-Threde GmbH, Munich, Germany), K. W. BENZ, M. SALK (Freiburg, Universitaet, Freiburg im Breisgau, Germany), I. V. BARMIN, A. V. EGOROV, A. S. SENCHENKOV (SPLAV Technical Centre, Moscow, Russia), and D. G. MATIUKHIN (Riga Scientific Research Institute for

Radioisotope Apparatus, Latvia) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p. Research supported by BMFT and DARA. refs
(IAF PAPER 92-0934) Copyright

A series of joint crystal growth experiments under microgravity was started in October 1991 with the growth of two CdTe crystals during the unmanned FOTON-7 mission. It is planned to continue this research by using the yearly flight opportunities. This paper presents Russian capsules, materials processing facilities, crystal growth experiments and new flight opportunities within the EUROKOSMOS project. Author

N92-19413# European Space Agency, Paris (France).
PROMOTION OF INDUSTRIAL DEVELOPMENT AND UTILISATION OF MICROGRAVITY IN SPACE: THE RADIUS REPORT

T.-D. GUYENNE, ed. Jun. 1991 31 p Original contains color illustrations
(ESA-BR-76; ISBN-92-9092-083-1; ETN-92-90750) Copyright
Avail: CASI HC A03/MF A01

In the Fall of 1990, the space commercialization office of ESA convened a task force of experts to examine the barriers which keep European industry from participating more actively in microgravity research efforts and to suggest ways to overcome these barriers. The experts were asked, in particular, to make suggestions for a business oriented strategy adapted to the particular requirements of the industrialists, and to make recommendations on ways to create the necessary synergies between industry and the research groups involved in microgravity research. The task force included representatives from space industry and space commercialization companies, in space user industry, and universities and research centers. The present report, based on the contributions of the members and the minutes of the meetings, summarizes the conclusions of the task force. The present participation of industry in microgravity research is described and a marketing approach to microgravity, designed to remove the different barriers that keep industry from being more active in this field is proposed. Specific problems of the microgravity research teams in universities and public research centers are addressed and it is shown that the present organization of microgravity research does not guarantee the best possible scientific results. The programs that have been set up by the U.S. and Japan to promote the participation of their industries in space programs are described. One possible way of encouraging the development of high level industrial microgravity research, through the creation of Research Associations for the Development of Industrial Utilisation of Space (RADIUS) is described. ESA

N92-24617# OHB-System G.m.b.H., Bremen (Germany).

BALLOON-BORNE DROP CAPSULE MIKROBA

K. KRETZSCHMAR (OHB-System G.m.b.H., Bremen (Germany, F.R.)), A. KELLIG (Kayser Threde G.m.b.H., Munich (Germany, F.R.)), and W. R. KUEBLER (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) / In ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 161-167 Nov. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The Mikroba (German acronym for microgravity with balloon) drop capsule is addressed. A stratospheric balloon about 615,000 cu cm will carry up a drop capsule with the capacity of up to 200 kg experimental payload to altitudes between 40 and 45 km. Reaching the operational altitude, the capsule will be released via telecommand. The g level 'switches' from 1 g to nearly zero g; microgravity conditions are realized inside the Mikroba capsule during the phase of free fall. A regulated cold gas thrust system compensates for the increasing aerodynamic drag to achieve up to 60 seconds micro g conditions in the region of 0.001 g. Parachute activation at an altitude between 20 and 14 km terminates the period of microgravity and guarantees a soft landing. ESA

ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

A92-39308

HOW TO PROMOTE ERROR TOLERANCE IN COMPLEX SYSTEMS IN THE CONTEXT OF SHIPS AND AIRCRAFT

JAMES REASON (Manchester, Victoria University, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 16.1-16.10. refs
Copyright

This paper looks at error tolerance from an organizational rather than an individual perspective. Many shipping and aircraft accidents have their primary origins in latent human failures; that is, fallible management decisions whose consequences may lie dormant for long periods before coming into adverse conjunction with local triggering factors to cause an accident. The paper reviews current ideas regarding the causes of accidents in complex, well-defended systems and equates the promotion of error tolerance with safety management procedures designed to detect and neutralized the consequences of these latent failures before they contribute to catastrophic accidents. Author

N92-12146# Aerospatiale, Paris (France).

ACLICO: AN AID SYSTEM FOR DESIGNING BONDED JOINTS [ACLICO: UN SYSTEME D'AIDE A LA CONCEPTION DES LIAISONS COLLEES]

MARTINE LABORIE 1991 16 p In FRENCH; ENGLISH summary
(REPT-911-430-134; ETN-91-90265) Avail: CASI HC A03/MF A01

Practical applications of artificial intelligence techniques in an industrial setting are outlined. ACLICO, an aid system for the design of bonded joints between materials, composite or otherwise, is described. The approach adopted, the architecture of the system, practical application of the system and the fallout observed are described. The computer assisted design system is best adapted to designing bonded joints between composite materials to be used in space applications. ESA

N92-18607# European Space Agency, Paris (France).

SPACE PRODUCT ASSURANCE FOR EUROPE IN THE 1990S: AN ESA SYMPOSIUM

JAMES J. HUNT, ed. Aug. 1991 289 p In ENGLISH and FRENCH Symposium held in Noordwijk, Netherlands, 15-19 Apr. 1991
(ISSN 0379-6566)

(ESA-SP-316; ISBN-92-9092-106-4; ETN-92-90460) Copyright
Avail: CASI HC A13/MF A03

Aspects of space product assurance programs for European space projects are discussed. Product assurance management relating to specifications and requirements is studied. Risk assessment and organizational robustness are discussed. Product assurance software is given special attention. Software dependability assessment and software control of hazards in space missions are discussed. Reliability, availability, maintainability and safety issues are considered. Safety risk management is discussed. Total quality management as a means of product assurance is considered from different perspectives. ESA

N92-18618# Bureau Veritas, Courbevoie (France).

ORGANISATIONAL ROBUSTNESS FOR MANNED SPACE FLIGHT

R. RECORD and J. L. DEMONTLIVAUT / In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 67-70 Aug. 1991

Copyright Avail: CASI HC A01/MF A03

In manned space programs the requirements for safety are considerably more stringent than those placed on earlier European space programs. Safety must be taken into account not simply during launch site operations but throughout the entire mission. Additionally, safety has become an important constraint at all phases of the project. The main threat to safety is organization malfunction. Development of an organization sufficiently robust to withstand such malfunctions is identified as an essential step towards the achievement of an acceptable level of safety. The safety approach envisaged for the manned space program is compared with that established for civil aviation. Organizational characteristics favorable for the achievement of safety are identified. ESA

N92-18624# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

SYSTEM SAFETY APPROACH IN MANNED SPACELAB MISSIONS FOR CONTROL OF HAZARDS BY SOFTWARE

D. BOHLE (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Bochum (Germany, F.R.)), W. ZIESMANN (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Bochum (Germany, F.R.)), and W. MARTIN (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 103-108 Aug. 1991
Copyright Avail: CASI HC A02/MF A03

In European manned missions, hazard control of safety critical systems are not realized entirely by software. At least one hardware inhibition exists. With the increasing capabilities of microprocessor systems, more and more hazards are controlled by S/W (software) in addition to be required H/W (hardware) inhibit. In previous missions this has been the exception. Wherever fault tolerance had to be assured, a failure of the S/W control meant termination of the mission for the affected facility. From a performance point of view this is a very undesirable solution. A software feature developed to overcome this situation in order to gain flexibility and to increase performance reliability is described. The necessary steps in safety certification are discussed using the D2 facility GFQ (Gradient Furnace with Quenching) as an example. An overview of S/W safety in space station applications is presented. ESA

N92-18635# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

SAFETY RISK MANAGEMENT FOR ESA SPACE SYSTEMS

K. M. WRIGHT *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium p 169-174 Aug. 1991
Copyright Avail: CASI HC A02/MF A03

ESA's safety program as defined in ESA PSS-01-40, system safety requirements for ESA space systems, comprise the systematic identification and evaluation of space system hazardous characteristics and their associated risks, together with a process of safety optimization through hazard and risk reduction, and implementation verification. This safety optimization and verification process is termed safety risk management. The fundamental principles of safety risk management are discussed. ESA

N92-18637# Technische Univ., Delft (Netherlands). Dept. of Mathematics.

WHY QUANTIFY RISK?

R. COOKE (Technische Univ., Twente (Netherlands)), B. FRISCH (Osterreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna (Austria)), and A. SALEEM (Osterreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna, Austria) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 179-183 Aug. 1991
Copyright Avail: CASI HC A01/MF A03

The topic of risk to human life is addressed from different viewpoints. The question is raised whether risk assessment is good only as a tool for ranking risk sources or whether it actually yields sensible numbers for estimating the risk of events. Various measures for the quantification of risk (e.g., deaths per million, activity specific hourly mortality rate) are given and their applications

are discussed. The implications of the different uses for risk numbers are explained. Known risks of several activities are used as a baseline for the discussion of the selection criteria for an achievable safety goal for manned space flight. ESA

N92-18649# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

SPECIFYING PA/SAFETY DESIGN TO REQUIREMENTS FOR THE COLUMBUS PROJECT AND GENERAL CONCLUSIONS

M. KASPER (European Space Research Lab., Noordwijk (Netherlands)), and W. GERICKE (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium p 253-258 Aug. 1991

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Product assurance (PA) and safety design to requirements are provided by the System Requirements Document (SRD) on the system level. These system level requirements contain technical requirements related to reliability, availability, maintainability, safety, PMP, and EEE parts in dedicated sections. In order to implement these requirements, the contractor needs to elaborate and refine them for the detailed design of the system. The requirements are to be apportioned further when establishing system, subsystem, and equipment level specifications. The Columbus process for establishing, refining, and tracing the requirements from ESA generated sets to industry (prime and lower tier contractors) generated design control requirements is described. ESA

N92-18650# Alcatel Espace, Toulouse (France).

FUTURE TECHNOLOGIES FOR SPACE: NEW PRODUCT ASSURANCE CONCEPTS

GUY GREGORIS and SABINE ROBICHEZ *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 259-266 Aug. 1991

Copyright Avail: CASI HC A02/MF A03

The quality and dependability approach established at Alcatel Espace to face the challenge of using the most advanced technologies in space program is described. From system to component level, the methods developed to comply with the space product assurance requirements are presented. ESA

N92-18655# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.

AN EVALUATION OF PAYLOAD SAFETY REQUIREMENTS FOR ESA MANNED SPACECRAFT

B. DORE (European Space Research Lab., Noordwijk (Netherlands)), A. MENZEL (Entwicklungsring Nord, Bremen (Germany, F.R.)), A. SALEEM (Osterreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna, Austria), and N WATTS *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium p 289-292 Aug. 1991

Copyright Avail: CASI HC A01/MF A03

There is a pressing need to establish more specific technical and programmatic safety requirements for certain types of ESA payloads, particularly for those to be utilized on ESA's future manned missions. The applicable safety requirements for each payload depend on many factors peculiar to the individual payload. The nature and purpose of the payload, the type of launcher system foreseen, and the payloads active location, particularly in manned space environment, are some of the principal drivers which may govern both technical and programmatic safety requirements. The future needs within ESA in this area are summarized. ESA

N92-19521# Norwegian Space Center, Oslo.

SPACE TECHNOLOGY AND INDUSTRIES IN NORWAY Annual Report, 1991

A.-L. RUUD HOLTET, ed. Jun. 1991 59 p
(NSC-REPT(91)-8; ISBN-82-7542-009-1; ETN-92-90809) Avail: CASI HC A04/MF A01

A short presentation of Norwegian Space Industry, the Norwegian Space Center, and some general information on space

31 ENGINEERING (GENERAL)

activities in Norway is given. The aim is to outline the industrial competence in Norway related to space and the experience and references of different firms. Industries active in space-related work are presented as well as research centers and institutes with strong industrial connection. ESA

N92-25666# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

THE HEAT PIPE HEAT EXCHANGERS: DESIGN, TECHNOLOGY AND APPLICATIONS

S. CHADOURNE *In VKI, Industrial Heat Exchangers* 16 p 1991

Copyright Avail: CASI HC A03/MF A06

The Heat Pipe Heat Exchanger (HPHE) is a relatively new and very attractive heat exchanger type. For a good understanding of this very special heat exchanger, a minimum knowledge of the heat pipes is required. The heat pipe and thermosyphon basic theory (including the calculation of the thermal limits) is summarized. Some information concerning the heat pipe technological aspects is given. A model of the HPHE is presented, and a design methodology using this model is described. The most interesting areas of applications of the HPHE are indicated and some examples are presented. ESA

N92-25850# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.

AN OVERVIEW OF ESA CRYOCOOLER ACTIVITIES

C. I. JEWELL *In its 4th European Symposium on Space Environmental Control Systems, Volume 1* p 195-199 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

With a significant number of future cryogenic cooling requirements incompatible with either radiative or cryogen cooling, a program of cryocooler developments which should lead to a range of 'space qualified' cryocoolers being commercially available for future users has been followed. An ESA 80 K 'Oxford type' cooler can presently be considered to be space qualified, while 20 and 4 K coolers are expected to be 'qualified' by 1992. Work is also being undertaken for the development of a 2.5 K cryocooler with 0.3 K as a future goal. The history of the 'Oxfordtype' cooler indicated that the design is based on an excellent pedigree and suggested future work should significantly increase the cryocoolers realm of applications. ESA

N92-25851# British Aerospace Public Ltd. Co., Bristol (England).

PRE-QUALIFICATION LEVEL TESTING OF AN 80 K STIRLING CYCLE COOLER

S. R. SCULL (British Aerospace Aircraft Group, Bristol (England).) and C. I. JEWELL (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In its 4th European Symposium on Space Environmental Control Systems, Volume 1* p 201-207 Dec. 1991

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The development and industrialization of a split Stirling cycle cooler for space applications capable of lifting 800 mW of heat at 80 K is considered. A cooler was manufactured as part of the first production batch and submitted to a prequalification level test program. Results of these tests which cover the following are presented: cooling performance, self induced vibration, launch vibration, electromagnetic compatibility, thermal vacuum tests, and life testing. ESA

N92-25853# Lucas Aerospace Ltd., Birmingham (England). Engine Systems Div.

THE DEVELOPMENT OF A RANGE OF LOW VIBRATION MECHANICAL CRYOCOOLERS FOR SPACE APPLICATION

BARRY N. HOCKING *In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1* p 217-221 Dec.

1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The history of an aerospace split reversed Stirling cycle cryocooler from the initial evaluation of the design to the space qualification is traced. The main design features of the cryocooler and the electronic controller are discussed together with a description of the latter two phases of the program. Both the initial performance and exported vibration test results obtained during the phase 2 program and the various models developed during this phase are discussed. The latest test results from the current phase 3 space cryocooler program are discussed together with space qualification and future cryocooler programs. ESA

N92-25875# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

DEVELOPMENT OF CRYOCOOLERS FOR SPACE APPLICATIONS USING HYDRODYNAMIC GAS BEARINGS

G. CLAUDET, L. DUBAND, A. RAVEX, and P. ROLLAND *In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1* p 393-396 Dec. 1991 Sponsored by CNES and DGA

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A development program of cryocoolers for space applications is currently in progress. The main feature is the use of hydrodynamic gas bearings. Functional mockups were built to characterize and demonstrate the feasibility of the concept. Presizing and optimization of the development model of a Vuilleumier engine was done. A first thermal compressor with a warm bearing (1000K) was built and operated. New components including a thermal compressor and a cold expander with room temperature bearings and linear actuator are under construction, or tests. A Stirling engine is also under development. A twin piston balanced pressure oscillator and a double staged cold expander were designed and are in a machining phase. ESA

N92-26986# Karlsruhe Univ. (Germany). Inst. fuer Technische Thermodynamik.

THE TRANSPIRATOR, AN EFFICIENT AND LIGHT EVAPORATIVE COOLER FOR SPACE TECHNOLOGY

M. ALF and G. ERNST *In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2* p 855-861 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The optimization of transpirators, light and efficient evaporative coolers, is considered. A program for computation of the maximum cooling capacity under given conditions, based on, test results is being developed. Advantages of the transpirators are: no loss of evaporating coolant in liquid or solid state; low weight and low volume; good adaptability to heat rejection at different temperature levels; numerous possibilities of configuration and subdivision. The mode of operation and design of the transpirators are described. Test results are presented. The influence of various components on the cooling capacity is shown. ESA

N92-32742# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany).

EXAMPLES OF ADVANCED NEAR-NET SHAPE MANUFACTURING TECHNIQUES FOR AEROSPACE

P.-J. WINKLER and H.-E. FRIEDRICH 1991 29 p Presented at the 1991 Advanced Aerospace Material/Processes Conference, Long Beach, CA, 20-24 May 1991 Submitted for publication (MBB-Z-0399-91-PUB; ETN-92-92118) Avail: CASI HC A03/MF A01

Aerospace industry manufacturing technology is reviewed. The following are described: development principles for materials and construction methods; influence of valuable materials; present and future requirements for metallic structural components in aircraft building; near-net shape technologies and typical applications; design and manufacturing principles for superelastic forming and the combination with diffusion bonding; the incremental forcing

process; further developments in investment casting. The need to rationalize manufacturing processes and the wish to obtain improved performance in aircraft will continue to provide the necessary impulse to develop innovative manufacturing methods. The development of suitable 'near-net shape' technologies will play an important part in the design of the aircraft of the future.

ESA

32

COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

A92-12290

POLISH RADAR TECHNOLOGY. II - ADAPTIVE RADAR AVIA CM

WIESLAW KLEMBOWSKI and JERZY PIKIELNY (Telecommunications Research Institute, Warsaw, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 752-755.

Copyright

The main goals of new Polish L-band ATC radar for en route control (AVIA CM) are presented. The design concept is described. AVIA CM main technical parameters are given. Some qualitative comparisons between experimental coverage diagrams of AVIA C and AVIA CM are made.

Author

A92-12291

POLISH RADAR TECHNOLOGY. III - WEATHER CHANNEL FOR PRIMARY SURVEILLANCE RADAR

WIESLAW KLEMBOWSKI (Telecommunications Research Institute, Warsaw, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 755-758.

Copyright

The general concept of weather channel, implemented into primary surveillance radar, is presented. The signal processing in weather channel and display of weather information are described. Some experimental results are discussed.

Author

A92-12293

POLISH RADAR TECHNOLOGY. V - ADAPTIVE MTI FILTERS FOR UNIFORM AND STAGGERED SAMPLING

ANDRZEJ WOJTKIEWICZ and MICHAL TUSZYNSKI (Warsaw University of Technology, Poland) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 760-767.

Copyright

The research on adaptive MTI filters in Poland is concentrated in two areas: theory of frequency analysis and optimal adaptive processing of nonuniformly sampled signals and development of uniformly sampled robust-adaptive MTI (AMTI) filters which are not sensitive to adverse effects of adapting to the target signal. Results obtained in these areas are briefly presented.

Author

A92-12299

ANALYSIS AND DESIGN OPTIMIZATION OF MONOPULSE RECEIVERS FOR SECONDARY SURVEILLANCE RADAR

KEVIN MCGRANE (Marconi Radar Systems, Ltd., Chelmsford, England) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 27, Sept. 1991, p. 838-852.

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Copyright

Monopulse techniques are widely employed for target location in air traffic control secondary surveillance radar systems. The sensitivity to calibration and component errors of the receiver configurations used in monopulse processing of secondary surveillance radar (SSR) replies is analyzed. The effects of video gain error in amplitude processors and large Gaussian perturbations in phase processors are introduced. Phase processors are shown

to be robust to variations in antenna difference pattern null depth. A half-angle phase processor is described which yields the benefits of phase processing without the sensitivity to system errors associated with conventional implementations.

Author

A92-17238

NEW PRACTICAL METHOD FOR MEASUREMENT ERROR DETERMINATION IN RADAR SYSTEMS UNDER REAL TRAFFIC CONDITIONS

C. FEIJOO, A. ASENSIO, and F. PEREZ (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) IEE Proceedings, Part F: Radar and Signal Processing (ISSN 0956-375X), vol. 138, Dec. 1991, p. 525-530. Research supported by CESELSA.

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A new practical approach is presented to aid the evaluation of radar systems. Plots from a data extractor are associated in tracks. Each track is processed through an interpolation filter to achieve a reasonable initialization of the maneuver detector. The tracking filter (alpha-beta) is not used to estimate the target state, but to estimate the measurement errors. The advantages of this new implementation are the simplicity, robustness and ease of testing because of the use of appropriately connected well known tracking algorithms. Finally, some results are introduced.

Author

A92-18509

COMMUNICATION SATELLITE SYSTEM BEYOND THE YEAR 2000

G. J. ROBERTSON (Matra Marconi Space, Portsmouth, England) and J. M. FOURQUET (Matra Marconi Space, Toulouse, France) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991, 8 p.

(IAF PAPER 91-495) Copyright

The primary evolutionary factors of satellite communications technologies are reviewed based on the results of a study of novel satellite developments. A critical evaluation of the viability and availability of the technologies is utilized in conjunction with market forecasts to determine promising commercial strategies. Modern technologies are almost prepared for the development of a class of communications satellites and include bandwidth utilization, spacecraft bus modularity, and functional integration.

C.C.S.

A92-34980

A SAR PROCESSOR FOR A GIS ENVIRONMENT

EINAR-ARNE HERLAND (Technical Research Centre of Finland, Espoo) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 623-626.

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A description is given of a SAR (synthetic aperture radar) processor that has been developed and implemented on a workstation and on a Cray supercomputer. The processor can process images from both satellite and aircraft SARs, and accommodates a wide range of processing parameters and output products. The SAR processor operates in an environment that also contains a large image processing software system and a geographic information system. The output of the processor is compatible with the formats used in the other two systems, and it is also being interfaced to a software package for accurate geometric correction and registration of the SAR images, in order to make the images directly available for further analysis.

I.E.

A92-42315

RADIATION AND COUPLING BETWEEN ANTENNAS MOUNTED ON A COMPLEX METALLIC STRUCTURE

M. BALMA and D. BRESCIANI (Alenia S.p.A., Caselle Torinese, Italy) IN: 1991 IEEE International Symposium on Electromagnetic Compatibility, Cherry Hill, NJ, Aug. 12-16, 1991, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 279-284.

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Copyright

32 COMMUNICATIONS AND RADAR

A hybrid UTD-MoM technique is applied to evaluate the radiation and the coupling among antennas mounted on the same structure. The most common application is represented by the electromagnetic characterization of an aircraft provided with either aperture antennas or wire antennas. After expanding the radiated far field with spherical sampling functions, both the directivity and the radiated power are evaluated by means of an analytical integration on the radiation pattern. Then the coupling among the antennas is computed and compared with some measurements performed on some simple geometrical bodies as far as on a scaled aircraft model. Author

N92-10114# Loughborough Univ. of Technology (England). Dept. of Electrical and Electronic Engineering.

THE DESIGN OF SPACEBORNE SYNTHETIC APERTURE RADAR M.S. Thesis

P. J. GOW 1988 128 p
(ETN-91-99986) Copyright Avail: CASI HC A07/MF A02

The design concepts, the potential applications and the construction of spaceborne SAR (Synthetic Aperture Radar) systems are examined and advantages of SAR over conventional radar, particularly at orbital altitudes are discussed. The Seasat A mission is used as a baseline system to assimilate an overall design procedure. The antenna, sensor, datalink and processor subsystems are examined in detail and potential improvements highlighted. A SAR design is proposed in the light of the Seasat post mission analysis and technological advances, and a range of operational modes of the system and how the design could be maximized for a variety of enduser requirements are explained. Military aspects and applications of spaceborne SAR are included. ESA

N92-11222# Loughborough Univ. of Technology (England). Dept. of Electrical and Electronic Engineering.

AN EXAMINATION OF THE FACTORS AFFECTING THE USE OF INFRA-RED SEARCH AND TRACK SYSTEMS IN THE AIR-TO-AIR ROLE M.S. Thesis

J. L. PILKINGTON 1989 279 p
(ETN-91-99987) Copyright Avail: CASI HC A13/MF A03

The employment of an IRSTS (Infrared Search and Track System) on a fighter aircraft is considered and the disadvantages of using radar to detect targets are explained. Atmospheric attenuation and scattering are investigated and optical terms and definitions are given. Thermal and photon detectors are examined. Problems associated with visual detection of targets on television type displays are discussed and the need for an automatic target detection process is highlighted. The performance of an imaging IRSTS is illustrated by simplified calculations and the future of IRSTS in the air to air role is discussed. ESA

N92-12156# Technische Hochschule, Darmstadt (Germany). Fachbereich Mathematik.

OPTIMALITY CONDITIONS FOR MINIMAX TASKS: AN APPLICATION EXAMPLE FROM COMMUNICATIONS ENGINEERING Ph.D. Thesis [OPTIMALITAETSBEDINGUNGEN FUER MINIMAX-AUFGABEN: EIN ANWENDUNGSBEISPIEL AUS DER NACHRICHTENTECHNIK]

DIRK KERBER 1990 69 p In GERMAN
(ETN-91-90169) Avail: CASI HC A04/MF A01

The internal relation of the various concepts from the theory of games, the approximation theory, and the convex optimization are explained, using the model for message transmission system. Necessary optimality conditions are given for the approximation problem. The model of a Pulse Amplitude Modulation (PAM) system is presented. The up to now unexplained existence of optimal transmission functions in single stage system is demonstrated. In three stage systems, the concept of a saddle point does not converge automatically towards solutions of minimax tasks. It is shown, that in this case, a saddle point prediction can be demonstrated for a convex fixed game. ESA

N92-12157# Norwegian Defence Research Establishment, Kjeller.

SAR IMAGING OF VORTEX SHIP WAKES. VOLUME 3: AN OVERVIEW OF PRE-ERS-1 OBSERVATIONS AND MODELS

AAGE SKOEELV and TERJE WAHL 23 May 1991 60 p
(ISSN 0802-2437)
(FFI-91/7007-VOL-3; ETN-91-90258) Avail: CASI HC A04/MF A01

The visibility of dark turbulent wakes in Synthetic Aperture Radar (SAR) imagery is focused upon. An overview of various wake observations prior to ERS-1 is given. This includes images from Seasat and airborne SAR as well as photographic observations. Different turbulent wake models and simulation, schemes are reviewed. The requirements for a complete turbulent wake model are discussed, and from results available, some conclusions are drawn with respect to possible ERS-1 applications. ESA

N92-14268# European Space Agency, Paris (France). Standards Approval Board for Space Data Communications.

RANGING STANDARD. VOLUME 1: DIRECT GROUND TO SPACECRAFT RANGING

Mar. 1991 38 p
(ISSN 0379-4059)
(ESA-PSS-04-104-VOL-1-ISSUE-2; ETN-92-90323) Copyright Avail: CASI HC A03/MF A01

Single access range and Doppler tracking on direct links between spacecraft of category A or category B missions and Earth based stations, are considered. The ranging standard is applicable to all ESA spacecraft that are supported for range or Doppler tracking by direct links to ESA controlled Earth stations operating in the Space Operations Service. Requirements concerning spacecraft transponders and Earth station equipment for the purposes of range and Doppler tracking are defined. Criteria by which one may determine the extent to which the accuracy of the measurements is influenced by equipment effects is provided. ESA

N92-15232# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Space Communications and Propulsion Systems Div.

LITE-SAT'S FOR SPECIFIC COMMUNICATION TASKS

H. DODEL and CH. RIEDL In ESA, Second European Conference on Satellite Communications (ECSC-2) p 153-158 Oct. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Since 1957 communications satellites have shown an ascending trend towards ever more gigantic platforms. Now this trend is reversing. Intelsat 7 falls short of its predecessor. At the same time lightsats, smallsats, and minisat's enter the scene. The scientific community, environmental research, and commercial users alike have begun to employ small spacecraft for specific communications tasks. Potential services that smaller satellites could serve adequately or even uniquely are considered and the market place and the market potential for the lightsats is depicted. An overview of the launch opportunities for these vehicles is given. The following questions are considered: how do smaller spacecraft perform in quality of manufacturing? What is the quality of manufacturing of their launchers and the reliability of the launches? Are the big platforms doomed? How reliable is commercial operation of the vehicle? What is the design maturity of spacecraft and launcher? What are the economics of the satellite production, the production of the launcher and the operational life of the satellite compared to conventional platforms? What is the intrinsic cost reduction potential of smaller satellites and economies of scale of a fleet of small satellites? How do efforts for scrapping compare for small spacecraft and, say, the 18 ton platform? ESA

N92-15272# Technology Development Corp., Madrid (Spain).

ELECTRONICALLY STEERABLE ANTENNA FOR AIRCRAFT

J. BARBERO, M. L. HERNANZ, M. HERNANZ, C. MARTIN, J. VASSALLO, and B. HEDGE In ESA, Second European Conference on Satellite Communications ECSC-2 p 425-427 Oct. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The design of an electronically steerable medium gain antenna for aircraft able to provide voice communication via satellite is presented. The antenna consists of 5 radiating facets and the coverages achieved, including the effect of the aircraft fuselage, are based on the experimental results obtained with the actual components of the beam forming network (switches, phase shifters, power dividers) and the radiating facets including the matching network. One hundred percent of the mandatory coverage (colatitude 0 to 85 degrees) is achieved with a gain greater than 10 dBi and 12 dBi are achieved in 60 percent of it. Concerning the goal coverage (colatitude 0 to 105 degrees) a gain greater than 7 dBi is achieved in 84 percent of it. The dimensions of the radome required for this antenna are: length 1780 mm, width 255 mm, height 197 mm. ESA

N92-15284# Polish Academy of Sciences, Warsaw.

THE CSMA/CD LOCAL AREA NETWORK FOR HOSPITAL SERVICES [LE RESEAU LOCAL CSMA/CD POUR LE SERVICE DES ETABLISSEMENTS HOSPITALIERS]

TADEUSZ NOWICKI /in ESA, Second European Conference on Satellite Communications (ECSC-2) p 491-494 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The present and future use of computers in hospitals is considered. Particular attention is given to the idea of installing magistral local area networks with multiple access and free choice type CSMA/CD (Carrier Sense Multiple Access with Collision Detection). The CSMA/CD method is discussed in detail. ESA

N92-15285# MATRA Espace, Toulouse (France).

NORMALIZATION, RELIABILITY AND VALIDATION OF INFORMATION FOR SPATIAL OPERATIONS [NORMALISATION, FIABILITE ET VALIDATION DE L'INFORMATION POUR LA CONDUITE DES OPERATIONS DES SPATIONEFS]

PHILIPPE PHAM (MATRA Espace, Toulouse (France).), PHILIPPE LEBOUAR (MATRA Espace, Toulouse (France).), and ANNICK SYLVESTRE-BARON (Centre National d'Etudes Spatiales, Toulouse, France) /in ESA, Second European Conference on Satellite Communications (ECSC-2) p 495-504 Oct. 1991 In FRENCH

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Methods and means of validation carried out to increase the operational security and to propose a structure of operational information for spatial operations are discussed. A complete run through of the information during the conception of satellite Telecom 2 is presented and the tools used to manage and treat the continuous flow of information throughout the entire duration of the mission are considered. The normalization of the information and the respective consideration given to the contributors allows multiple validations which make the operational information more reliable and reduces the risk of errors and free interpretations in the transfer of knowledge about the satellite. ESA

N92-19151# Alenia, Torino (Italy).

PARAMETRIC BICUBIC SPLINE AND CAD TOOLS FOR COMPLEX TARGETS SHAPE MODELLING IN PHYSICAL OPTICS RADAR CROSS SECTION PREDICTION

A. DELOGU and F. FURINI /in AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance 13 p Sep. 1991

Copyright Avail: CASI HC A03/MF A03

Increasing interest in radar cross section (RCS) reduction is placing new demands on theoretical, computation, and graphic techniques for calculating scattering properties of complex targets. In particular, computer codes capable of predicting the RCS of an entire aircraft at high frequency and of achieving RCS control with modest structural changes, are becoming of paramount importance in stealth design. A computer code, evaluating the

RCS of arbitrary shaped metallic objects that are computer aided design (CAD) generated, and its validation with measurements carried out using ALENIA RCS test facilities are presented. The code, based on the physical optics method, is characterized by an efficient integration algorithm with error control, in order to contain the computer time within acceptable limits, and by an accurate parametric representation of the target surface in terms of bicubic splines. Author

N92-19155# Aeritalia S.p.A., Rome (Italy).

USE OF TARGET SPECTRUM FOR DETECTION ENHANCEMENT AND IDENTIFICATION

S. PARDINI (Alenia Spazio S.p.A., Rome (Italy).), P. F. PELLEGRINI (Florence Univ., Italy), and P. PICCINI /in AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance 12 p Sep. 1991

Copyright Avail: CASI HC A03/MF A03

Modulation on the echo signal generated by rotating machinery of an air target is addressed. An extensive measurement campaign was carried out by means of an air traffic control radar and some preliminary results are presented. The problem of target spectra characterization and exploitation for detection enhancement and target identification, is considered in relation with the limitation imposed by the present radar features. Some considerations regarding the application of this technique for non-cooperative target recognition, in the radar of future generation, are developed. Author

N92-19164# Rutherford Appleton Lab., Chilton (England). Radio Communications Research Unit.

REDUCTION OF TARGET SCATTERING BY TROPOSPHERIC MODIFICATION

K. H. CRAIG /in AGARD, Target and Clutter Scattering and their Effects on Military Radar Performance 12 p Sep. 1991 Sponsored by European Office of Aerospace Research and Development

Copyright Avail: CASI HC A03/MF A03

This paper examines the possibility of reducing the effective radar cross-section of an aircraft by actively modifying the refractive index of the air surrounding it. The mechanism proposed is heating of the atmosphere by a laser mounted on the aircraft. The equations for the refractive index changes caused by absorption of laser radiation are derived, and refractive index profiles are calculated. A shielding factor specifying the reduction in target cross-section is introduced. The shielding factor is evaluated for typical laser beam geometries by using these profiles in a parabolic equation based electromagnetic propagation model. A parametric study is presented in order to optimize the laser wavelength and beam geometry. It is concluded that laser powers in the megawatt range can yield shielding factors greater than 10 dB. A 10.6 micron CO₂ laser appears to be optimum in terms of efficiency of cross-section reduction, and is also the laser type for which the highest CW powers are achievable. Author

N92-24073*# International Maritime Satellite Organization, London (England).

IMPLEMENTATION OF INMARSAT MOBILE SATCOM SYSTEMS

HANS-CHR. HAUGLI /in JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 8-12 1990

Described here is the new mobile satcom systems being implemented by Inmarsat. Inmarsat has traditionally provided professional communication to ships and is now actively implementing new systems for use on land, in the air, and at sea. These new systems can provide near global communication for anyone on the move. By 1993, four new systems will provide telephony, telex, data, group call and facsimile at affordable cost to a very wide range of users. A table giving the main technical parameters for Inmarsat Aeronautical, Inmarsat-B, C, and M systems is provided. Author

N92-24095*# International Maritime Satellite Organization, London (England). Aeronautical Services Div.

AERONAUTICAL SATELLITE SYSTEM TEST AND IMPLEMENTATION Abstract Only

KEITH SMITH /In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 149 1990

This contribution reports on various aspects of the test and implementation of the new worldwide aeronautical satellite system. The system will be implemented in 1990 following several years of system design and equipment development. The full range of services and equipment will not be available immediately, but rather there will be a progressive phase-in over the first two years of service. Data services using low gain aircraft antennas are planned to be introduced first. Voice service, requiring high gain antennas is expected to begin on a full scale basis about May/June 1990. This contribution explains Inmarsat's approach to testing and authorization of equipment intended to make use of its satellites in this evolving situation. The approach is designed to permit progressive implementation of services while avoiding the need for large scale retrofitting of equipment which has already been introduced into service. Author

N92-24098*# International Maritime Satellite Organization, London (England).

INMARSAT AERONAUTICAL MOBILE SATELLITE SYSTEM: INTERNETWORKING ISSUES

JAY R. SENGUPTA /In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 163-168 1990

The Inmarsat Aeronautical Mobile Satellite System (AMSS) provides air-ground and air-air communications services to aero-mobile users on a global basis. Communicating parties may be connected either directly, or more commonly, via interconnecting networks to the Inmarsat AMSS, in order to construct end-to-end communications circuits. The aircraft earth station (AES) and the aeronautical ground earth station (GES) are the points of interconnection of the Inmarsat AMSS to users, as well as to interconnecting networks. This paper reviews the internetworking aspects of the Inmarsat AMSS, by introducing the Inmarsat AMSS network architecture and services concepts and then discussing the internetwork address/numbering and routing techniques. Author

N92-24167*# International Maritime Satellite Organization, London (England).

FUTURE DEVELOPMENTS IN AERONAUTICAL SATELLITE COMMUNICATIONS

PETER WOOD /In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 587-592 1990

Very shortly aeronautical satellite communications will be introduced on a world wide basis. By the end of the year, voice communications (both to the cabin and cockpit) and packet data communications will be available to both airlines and executive aircraft. During the decade following the introduction of the system, there will be many enhancements and developments which will increase the range of applications, expand the potential number of users, and reduce costs. A number of ways in which the system is expected to evolve over this period are presented. Among the issues which are covered are the impact of spot beam satellites, spectrum and power conservation techniques, and the expanding range of user services. Author

N92-25378 Physics and Electronics Lab. TNO, The Hague (Netherlands).

SET-UP AND ALIGNMENT ASPECTS OF A CO₂-LASER RADAR FOR APPLICATIONS IN THE FIELD Final Report

H. HEBERS Jun. 1991 29 p (Contract A90KL621)

(FEL-91-A162; TD91-2229; ETN-92-91214; AD-A245623)

Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

The setup of a multifunctional CW CO₂ (Continuous Wave carbon dioxide) laser radar system is described. Special attention is given to some recent modifications. They consist mainly of the addition of an Acousto-optic Modulator (AOM) in the local oscillator beam of the heterodyne detection system, and of the renewal of the HgCdTe detector. The added AOM shifts the frequency, at which heterodyne detection is performed, from the previous 100 to 140 MHz now. This implied that the processing electronics of the set up also had to be adapted. A step by step procedure for the optical alignment of the system is presented. ESA

N92-25668# European Space Agency, Paris (France).

RADARS AND LIDARS IN EARTH AND PLANETARY SCIENCES

T.-DUC GUYENNE, ed. and JAMES J. HUNT, ed. Dec. 1991 139 p Symposium held in Cannes, France, 2-4 Sep. 1991; sponsored by NASA, AAF, Italian Space Agency, and CNES (ESA-SP-328; ISBN-92-9092-154-4; ISBN-0379-6566; ETN-92-91382) Copyright Avail: CASI HC A07/MF A02

Radar and lidar applications and techniques in Earth and planetary sciences are discussed. Ground based and bistatic observations of near Earth asteroids and space debris are discussed. Aspects of spaceborne laser use in the Magellan mission to Venus are described. Subsurface radar and synthetic aperture radar to be used on the mission to Mars are discussed. The Cassini radar, the radars aboard ERS-1, and the Canadian Radarsat program are described. Research and development on lidar systems and solid state lasers are discussed. ESA

N92-28529# Thomson-CSF, Malakoff (France).

INTEREST IN REAL-TIME SIMULATIONS FOR THE DEVELOPMENT TERRAIN FOLLOWING FUNCTION OF RADAR SYSTEMS [INTERET DES SIMULATIONS 'TEMPS REEL' POUR LE DEVELOPPEMENT DE LA FONCTION SUIVI DE TERRAIN DES SYSTEMES RADAR]

T. MARTINET /In AGARD, Piloted Simulation Effectiveness 5 p Feb. 1992 In FRENCH; ENGLISH summary Copyright Avail: CASI HC A01/MF A03

During a penetration mission, modern tactical aircraft have to fly over regions with heavy electromagnetic environments. To realize such a mission, a minimum knowledge of terrain elevation is needed. Terrain elevation knowledge can be obtained from real time sensors such as radar. The development of terrain following function becoming more and more complicated, it necessitates the use of simulations to analyze the performance of sophisticated data processing and flight control. The aim of this paper is to demonstrate the contribution of interactive real time simulations during the phase of development to optimize radar resources management, in different types of terrain and many configurations of electronic warfare. It is then shown how the operational people can take part to the definition of the radar to obtain the most appropriate comportment. It is finally described how to characterize the radar performances in the complete weapon system and observe the manifestation of error simulation on the security of the system. Author

N92-29877# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. Hochfrequenzphysik.

GLOBAL AND HIGH RESOLUTION RADAR CROSS SECTION MEASUREMENTS AND TWO-DIMENSIONAL MICROWAVE IMAGES OF A SCALED AIRCRAFT MODEL FROM THE TYPE AIRBUS A 310 [GLOBALE UND HOCHAUFGELOESTE RADARRUECKSTRAHLQUERSCHNITT-MESSUNGEN UND ZWEIDIMENSIONALE MIKROWELLENABBILDUNGEN VON EINEM SKALIERTEN UND FLUGZEUGMODELL VOM TYP AIRBUS A 310]

KARL-HEINZ BETHKE Jun. 1991 54 p In GEORGIAN (ISSN 0939-298X)

(DLR-MITT-91-10; ETN-92-91731) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

The results from radar cross section high resolution measurements of a metallized scaled model of a usual airliner of the Airbus A310 type are presented. The measurements were performed for line polarization states by using a coherent short pulse radar at a frequency of 12.5 GHz. Two dimensional microwave images were generated for varied aspect angles by using inverse synthetic aperture principles to obtain an exact identification of each scattering center of the model. Polarization dependent back diffusions are particularly visible at the wing edges in the respective reflection images. The fins of airfoils are visible by vertical polarization for aspect angles from side views. ESA

N92-30941* # Florence Univ. (Italy). Dipt. di Ingegneria Elettronica.

ISSUES FOR THE INTEGRATION OF SATELLITE AND TERRESTRIAL CELLULAR NETWORKS FOR MOBILE COMMUNICATIONS

ENRICO DELRE, IGNAZIO MISTRETTA (Telespazio, S.p.A., Rome, Italy), FRANCESCO DELLIPRISCOLI (Telespazio, S.p.A., Rome, Italy), and FRANCO SETTIMO (Centro Studi e Laboratori Telecomunicazioni, Turin, Italy) In JPL, Proceedings of the Workshop on Advanced Network and Technology Concepts for Mobile, Micro, and Personal Communications p 241-262 15 Sep. 1991

Avail: CASI HC A03/MF A03

Satellite and terrestrial cellular systems naturally complement each other for land mobile communications, even though present systems have been developed independently. The main advantages of the integrated system are a faster wide area coverage, a better management of overloading traffic conditions, an extension to geographical areas not covered by the terrestrial network and, in perspective, the provision of only one integrated system for all mobile communications (land, aeronautical, and maritime). To achieve these goals, as far as possible the same protocols of the terrestrial network should be used also for the satellite network. Discussed here are the main issues arising from the requirements of the main integrated system. Some results are illustrated, and possible future improvements due to technical solutions are presented. Author

33

ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

A92-20131 LIGHTNING STRIKE SIMULATION USING COAXIAL LINE TECHNIQUE AND 3D LINEAR INJECTION CURRENT ANALYSIS

F. FLOURENS (Societe Gerac, Gramat, France), D. GAUTHIER, and D. SERAFIN (Gramat, Centre d'Etudes, France) International Conference on Lightning and Static Electricity, University of Bath, England, Sept. 26-28, 1989. 8 p. refs

The GORFFD code for determining aircraft responses to either a lightning event or to simulated current injection is based on the finite-difference solution of Maxwell's equation, and allows the simulation of complex, 3D metallic and dielectric composite structures. A transfer method is used to analyze the EM environment associated with in-flight measurements. Attention is given to a linear-analysis numerical model in which the lightning channel is simulated as a thin wire that is driven by a current source. Surface E-fields and current mappings are produced for the Transall transport and Mirage fighter aircraft. An experimental method has been devised for verification of these lightning-strike simulations. O.C.

A92-23042

ARCHITECTURE AND INTERCONNECTS OF PROGRAMMABLE PROCESSORS OF RADAR SIGNALS [ARCHITECTURE ET CONNECTIQUE DE PROCESSEURS PROGRAMMABLES DE SIGNAUX RADARS]

C. VERGNOLLE (Thomson-CSF, Malakoff, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), 3rd Quarter, 1991, 1991, p. 21-25. In French.

Copyright

After discussing the processing architecture for the Rafale-aircraft radar signals, the paper examines a future-generation radar with beam forming which will require computation powers of several tens of giga-operations per second. In this case it will be necessary to use several hundred programmable processors in a massively parallel architecture. These architectures require the development of reconfigurable interconnection networks on active silicon and direct module-to-module 3D interconnects. L.M.

A92-23301

EFFECTS OF IONIZING AND NONIONIZING RADIATION ON AIRCRAFT [EFFETS DES RAYONS IONISANTS ET NON IONISANTS SUR LES AERONEFS]

P. MORIN (DGA, Issy-les-Moulineaux, France) L'Onde Electrique (ISSN 0030-2430), vol. 72, Jan.-Feb. 1992, p. 9-11. In French.

Copyright

It is pointed out that a nuclear explosion has a two-fold effect on electronic components due to X-rays and gamma-rays and to the electromagnetic wave generated. The present study shows the influence of the combination of these two types of effects on an aircraft whose action as a Faraday shield is reduced by the use of composite materials. It is noted that helicopters are especially vulnerable to such effects because of their technology. The difficulties involved in performing comprehensive tests have led to the use of mathematical models combined with partial tests. L.M.

A92-38971

HIGH TEMPERATURE SUPERCONDUCTING VORTEX FLOW TRANSISTOR

J. S. SATCHELL, J. A. EDWARDS, N. G. CHEW, and R. G. HUMPHREYS (Defence Research Agency, Malvern, England) Electronics Letters (ISSN 0013-5194), vol. 28, no. 8, April 9, 1992, p. 781-783. refs

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The fabrication of a multiloop vortex flow transistor based on a controlled junction technology using high temperature superconductor thin film is reported. The junction technology used is based on the growth of a film of YBaCuO₇ by e-beam evaporation on a single crystal substrate of MgO with a lithographically defined step. Although the present device does not show current gain, the device characteristics are generally in agreement with expectations, indicating excellent matching between junctions. V.L.

A92-54678

MECHANISMS OF HIGH-CURRENT PULSES IN LIGHTNING AND LONG-SPARK STEPPED LEADERS

S. LARIGALDIE (ONERA, Chatillon, France), A. ROUSSAUD, and B. JECKO (Limoges, Universite, France) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 5, Sept. 1, 1992, p. 1729-1739. Research supported by DRET. refs

(ONERA, TP NO. 1992-202) Copyright

The mechanisms of high-current transients in lightning stepped leaders and in long laboratory sparks at negative polarity are analyzed both from improved time resolution measurements and from systematic identifications of the various elements of the discharge during a pulse. A qualitative model was first constructed when the observations made were correlated with some previously known basic phenomena. Then the model was made quantitative by means of a computer simulation of spark formation, carried out from a modified program in electromagnetics. The relevance of the proposed model was checked for long sparks at negative

polarity when computed and recorded current pulse wave forms were compared. Finally, the model of stepped-leader development was applied to a full scale event: an in-flight lightning strike on an instrumented aircraft. Slight discrepancies between computed and recorded current pulse wave forms may indicate possible underestimation of the electromagnetic high-frequency threat to sensitive airborne equipment due to the frequency limitations of the transient recorders used for lightning characterization on aircraft. Author

N92-12184# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.

THE STABILITY OF GRAPHITE BRUSHES AT HIGH VELOCITY Ph.D. Thesis [ZUR STABILITÄT VON KOHLEBURSTEN BEI HOHER GESCHWINDIGKEIT]

ARWED R. UECKER 1990 82 p In GERMAN (ETN-91-90176) Avail: CASI HC A05/MF A01

The unequal current distribution between parallel switched graphite brushes on high velocity slip rings, is examined. It is shown that the formation of a particular contact film on the graphite brush surface is possible. The properties and physicochemical texture on the contact film can be determined, and the influence on current distribution can be demonstrated. Using Raman spectroscopy and electron diffraction, it is shown that the contact film is composed of very tiny and mean crystallite bulk. An analytical examination of the dynamics of graphite brushes shows that, under determined conditions, an aerodynamical oiling wedge is formed, which leads to contact guidance. Theoretical calculation demonstrates experimental results. ESA

N92-18630# MATRA Espace, Toulouse (France).

SYSTEMS SAFETY: PRACTICAL EVALUATION OF SNEAK CIRCUIT ANALYSIS APPLIED TO CASE STUDIES

P. CHARON (MATRA Espace, Paris-Velizy (France)), J. M. JEANDUPEUX (CEP Systemes, Paris (France)), A. LEHENAFF (Alcatel Espace, Toulouse (France)), J. MIGNOT (Centre National d'Etudes Spatiales, Paris (France)), and O. NICOLAS (CEP Systemes, Toulouse, France) In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 141-145 Aug. 1991

Copyright Avail: CASI HC A01/MF A03

The main benefits and questions arising from the application of sneak circuit analysis methods to systems safety studies are discussed. To assess the method, CNES, DGA and ESA gathered to get three case studies performed by Alcatel Espace and Matra Espace. The method is based on the scanning of a clues list in order to point out potential design problems such as sneak paths, and technological or timing compatibility. The activity is organized into five main steps to prepare and report the results. The U.S. standard procedures are compared with the procedure applied to the three cases. ESA

N92-25307# Technische Univ., Delft (Netherlands).

VORTEX DYNAMICS IN ARTIFICIALLY FABRICATED SUPERCONDUCTING NETWORKS Ph.D. Thesis

HERRE SJOERD JAN VANDERZANT 1991 138 p (ETN-92-91296) Avail: CASI HC A07/MF A02

An experimental study on vortex dynamics in artificially fabricated superconducting networks is presented. The measurements concentrated on electrical transport properties. The resistance of these superconducting networks was measured as a function of temperature, magnetic field, and applied current. The following studies are presented: vortex dynamics in Josephson junction arrays; the superconducting transition of two dimensional Josephson junction arrays in a small perpendicular magnetic field; phase transition of frustrated two dimensional Josephson junction arrays; phase fluctuations in two dimensional superconducting weakly coupled wire networks; coherent phase slip in arrays of underdamped Josephson tunnel junctions; dynamics of vortices in underclamped Josephson junction arrays; ballistic vortices in Josephson junction arrays; and quantum vortices near the field tuned transitions in Josephson junction arrays. ESA

N92-25852# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

A HEAT SWITCH FOR SPACE CRYOCOOLER APPLICATIONS

S. VANOOST (Societe Anonyme Belge de Constructions Aeronautiques, Brussels.), G. BEKAERT (Societe Anonyme Belge de Constructions Aeronautiques, Brussels.), R. S. BHATTI (Societe Anonyme Belge de Constructions Aeronautiques, Brussels.), S. SCULL (British Aerospace Aircraft Group, Bristol (England).), and C. I. JEWELL (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 209-216 Dec. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A new passive cryogenic heat switch which is capable of thermally disconnecting a nonoperating cryocooler is considered. The design uses the principle of an amplified differential contraction between two dissimilar materials with metal-metal contact and a flexible coupling. An on resistance of 3.64 K/W and an off resistance of greater than 2000 K/W was measured. The switching temperature can be easily adjusted but was set up to be approximately 150 K for the 80 K coolers used in this study. Thermal vacuum and shaker vibration tests are presented. ESA

N92-26974# Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers (France). Lab. de Thermique.

INTEGRATED HEAT PIPE CONCEPT FOR LI/SOCL2 CELLS COOLING

A. SULEIMAN (Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers (France)), A. ALEXANDRE (Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers (France)), and J. L. FIRMIN (Société des Accumulateurs Fixes et de Traction, Romainville, France) In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 779-783 Dec. 1991 Sponsored by Société des Accumulateurs Fixes et de Traction

Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A new thermal control system based on heat pipe to support the development of a primary lithium/thionyl chloride (Li/SOCl₂) battery designed for future space applications is shown. Performances of the used heat pipe are considered and range performances of a traditional cell cooling concept based on the use of an aluminum pipe put around the cell and fixed to a coldplate is shown. A mock up was carried out and compared to thermal model of the whole system using ESACAP software. This model includes about 120 nodes to present the cell and the aluminum pipe. These results are compared to those of the proposed new cooling concept based on a grooved nickel/F11 heat pipe integrated in the cell. In this case, a mock up was performed and a corresponding nodal model was built. The experimental and modeling results show that the new concept decreases thermal gradient and weight and increases the available current discharge rate compared with the traditional cooling concept. ESA

N92-27118*# Aerospatiale, Cannes (France). Space and Strategic Systems Div.

EFFECTS OF ULTRA-VACUUM AND SPACE ENVIRONMENT ON CONTACT OHMIC RESISTANCE: LDEF EXPERIMENT AO 138-11

JEAN-PIERRE ASSIE and ALFRED PEROTTO In NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 3 p 1607-1611 Jan. 1992

Avail: CASI HC A01/MF A04; 1 functional color page

The FRECOPA experimentation of chemical resistance of electrical connector contacts, as described, has evidenced the detrimental time variations of nickel plated conductors and gilded copper contacts, irrespective of crimping storage or metal peening conditions. With a view to reorient aluminum technology a silvered aluminum conductor/gilded aluminum contact solution was evaluated. Author

N92-27789*# Southampton Univ. (England). Inst. of Cryogenics.

MAGNETIC SUSPENSION USING HIGH TEMPERATURE SUPERCONDUCTING CORES

R. G. SCURLOCK / In NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 507-517 May 1992
 Avail: CASI HC A02/MF A04

The development of YBCO high temperature superconductors, in wire and tape forms, is rapidly approaching the point where the bulk transport current density j vs magnetic field H characteristics with liquid nitrogen cooling will enable its use in model cores. On the other hand, BSCCO high temperature superconductor in wire form has poor j - H characteristics at 77 K today, although with liquid helium or hydrogen cooling, it appears to be superior to NbTi superconductor. Since liquid nitrogen cooling is approx. 100 times cheaper than liquid helium cooling, the use of YBCO is very attractive for use in magnetic suspension. The design is discussed of a model core to accommodate lift and drag loads up to 6000 and 3000 N respectively. A comparison is made between the design performance of a liquid helium cooled NbTi (or BSCCO) superconducting core and a liquid nitrogen cooled YBCO superconducting core. Author

34

FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

A92-10036
HIGH RESOLUTION SCHEMES FOR STEADY FLOW COMPUTATION

Z. WANG and B. E. RICHARDS (Glasgow, University, Scotland) Journal of Computational Physics (ISSN 0021-9991), vol. 97, Nov. 1991, p. 53-72. Research sponsored by British Council. refs
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It is pointed out that the ability of TVD schemes to resolve viscous shear layers is still quite unclear. By unifying and comparing two TVD schemes, the Osher-Chakravarthy and the Yee scheme, it is found that the former is much less dissipative than the latter. When a viscous solution at high Reynolds number is sought, they could result in dramatically different solutions. It is demonstrated that the dissipation imbedded in the schemes may be the cause. When physical dissipation is overwhelmed by numerical dissipation, the solution will be unrepresentative; and a 'numerical solution' in this case will be worthless. It is concluded that the goal then is to resolve the problem with the least numerical dissipation possible, and it is suggested that the modified Yee schemes be used to approach this goal. L.M.

A92-10037
VECTORISING THE SMOOTH PARTICLE HYDRODYNAMICS

B. HADDAD (Paris, Observatoire, Meudon, France), F. CLAUSSET, and F. COMBES (Paris, Observatoire, Meudon; Ecole Normale Supérieure, Paris, France) Journal of Computational Physics (ISSN 0021-9991), vol. 97, Nov. 1991, p. 103-126. refs
 Copyright

A novel method for vectorizing the smooth particle hydrodynamics (SPH) code is described which has the advantages of being Lagrangian and of simple conception; in addition, the code introduces little dissipation, in contrast to grid-dependent algorithms. In this vectorized code, the CPU time increases linearly with the number of particles, which is due to the constant number of neighbors necessary to assure good accuracy and to the algorithm that suppresses all unnecessary calculations. This makes it possible to handle many more particles and to significantly improve the dynamics. L.M.

A92-10654

BIENNIAL FLUID DYNAMICS SYMPOSIUM ON ADVANCED PROBLEMS AND METHODS IN FLUID MECHANICS, 19TH, KOZUBNIK, POLAND, SEPT. 3-8, 1989, SELECTED PAPERS

Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 42, no. 4-5, 1990, 205 p. For individual items see A92-10655 to A92-10663.

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Various papers on mechanics are presented. Individual topics addressed include: dynamics of the wall jet in transcritical regime, hydrodynamics of dispersions including diffusional effects, rotating disks flow under highly reduced gravity: infinite disks with different velocities rotating at moderate Re , formation of strong pressure pulses reflected from water-bubble layers, thermal-stress gas flows, generalized dynamical similarity numbers derived from Lagrangian's dynamics and Hamilton's canonical equations, numerical studies of Rayleigh-Taylor instability by the vortex method, splashing of drops, parameterization of the dissipation mechanisms in surface waves induced by wind. Also discussed are: Maxwell molecular collision model in kinetic theory of gases, two-layer flow stability of viscoelastic fluids in a circular pipe, shock wave reflection close to the leading edge of a wedge, thermocapillary flow in a rapidly rotating cylinder with a free inner surface, Liapunov's direct method in problems of fluid equilibrium instability, unsteady incompressible viscous flow past an airfoil, just-attached shock wave at the leading edge of a profile $M(\infty)$ greater than about one. C.D.

A92-10658
NUMERICAL STUDIES OF RAYLEIGH-TAYLOR INSTABILITY BY THE VORTEX METHOD

H. KUDELA (Wroclaw, Technical University, Poland) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers. A92-10654 01-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 42, no. 4-5, 1990, p. 493-505. refs

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The results of a numerical investigation of Rayleigh-Taylor instability in an inviscid, incompressible flow by vortex methods was presented. The numerical procedure was briefly described. The effect of surface-tension on the smoothing of irregular motion of vortices in the vortex simulation of Rayleigh-Taylor instability is shown. The irregular motion appears as an effect of short-wave disturbances, the source of which is a round-off error. Inclusion of surface tension allows for the observation of the formation of singularities. The singularities make an infinite jump discontinuity in the curvature of the vortex sheet. It is observed that, for a sufficiently small Atwood number and for initial amplitude perturbation large enough, two singularities appear in a half period of the vortex sheet and only one appears for greater Atwood numbers. The results for desingularized equations of motion were also presented. Desingularization was made by introducing the delta-square parameter to the Cauchy type integral; in this way the singularity of the integrand was removed. Author

A92-10689
STEADY AND UNSTEADY 3D INTERACTIVE BOUNDARY LAYERS

F. T. SMITH (University College, London, England) Computers and Fluids (ISSN 0045-7930), vol. 20, no. 3, 1991, p. 243-268. Research supported by U.S. Navy, United Technologies Corp., SERC, et al. refs
 Copyright

The paper describes theoretical and computational research on 3D steady and unsteady flows at medium-to-high Reynolds numbers (Re), aimed at increasing understanding of 3D separation and boundary-layer transition. Concerning steady 3D flows first, an interactive-boundary-layer (IBL) formulation for 3D laminar flow of an incompressible fluid over a surface-mounted obstacle is addressed computationally and compared with other methods at various Re . The computational approach is designed deliberately to capture the extra ellipticity present due to the three-dimensionality, making use of skewed shears in linear

quasi-planar sweeps of the boundary layer and local updating in the 3D interaction law. Results including separation are presented for a range of Re and obstacle heights, together with grid-effect studies, and comparisons are made, first with triple-deck predictions for high Re and, second, with an alternative IBL approach presented in a companion work. The latter and the current work together yield a broad agreement on predictions for the 3D flow, stretching from the triple-deck through the IBL to thin-layer Navier-Stokes predictions, over a wide range of Re. Second, the computational approach is extended to unsteady 3D flows, for the triple-deck limit including linear and nonlinear Tollmien-Schlichting waves. Results for small and nonsmall disturbances and comparisons are presented, showing fairly encouraging agreement between theory, computations and experiments. Author

A92-11219 TOPOLOGY OF STEADY FLOWS OF LOW VISCOSITY FLUIDS [TOPOLOGIE DES ECOULEMENTS PERMANENTS DE FLUIDES PEU VISQUEUX]

R. LEGENDRE (Academie des Sciences, Paris, France) *Revue Scientifique et Technique de la Defense* (ISSN 0994-1541), 1st Quarter, 1991, p. 67-75. In French. refs
Copyright

A study is presented to evaluate wind tunnel and water tunnel observations as shown in the tests performed on the Concorde wing. These tests revealed the eddies that required elimination to restrict drag and emitted noise. Consideration is given to the validity of topology rules for any continuous vector field. R.E.P.

A92-11225 THE ENIGMATIC MERGING CONDITIONS OF TWO-LAYER BAROCLINIC VORTICES

JACQUES VERRON and EMIL J. HOPFINGER (Grenoble, Institut de Mecanique, France) *Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de la Terre et de l'Univers* (ISSN 0764-4450), vol. 313, no. 7, Sept. 26, 1991, p. 737-742. refs
Copyright

The influence of stratification on geostrophic vortex merging is examined by employing numerical simulations and the results of laboratory experiments. It is shown that the vertical flow structure and the details of the initial vortex horizontal profiles are of critical importance to baroclinic vortex merger. R.E.P.

A92-13671 EXPERIMENTAL TESTING OF TAYLOR'S HYPOTHESIS BY L.D.A. IN HIGHLY TURBULENT FLOW

A. CENEDESE, G. P. ROMANO (Roma I, Universita, Rome, Italy), and F. DI FELICE (Centro Italiano Ricerche Aerospaziali, Capua, Italy) *Experiments in Fluids* (ISSN 0723-4864), vol. 11, no. 6, Oct. 1991, p. 351-358. refs
Copyright

A new configuration for the transmitting optics of a laser Doppler anemometer has been developed in order to measure the velocity at two different points at the same time. From the simultaneous measurements at two points along the mean flow direction, it is possible to evaluate the spatial correlations and to compare them with the temporal correlation to verify the validity limits of Taylor's hypothesis, also known as the frozen turbulence hypothesis. The transfer function between the velocity signals at two different points has been introduced to better explain the differences between Taylor's hypothesis and non-frozen flow. The analysis is carried out in a flow with high turbulence levels. Author

A92-15483 DIRECT SIMULATION OF THREE-DIMENSIONAL TURBULENCE IN THE TAYLOR-GREEN VORTEX

M. E. BRACHET (Ecole Normale Supérieure, Paris, France) *Fluid Dynamics Research* (ISSN 0169-5983), vol. 8, Oct. 1991, p. 1-8. refs

(Contract DRET-87-1483)

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The incompressible Navier-Stokes equations are numerically

integrated on a Cray-2 machine with the periodic Taylor-Green initial data. Using a spectral method taking advantage of the symmetries of the flow, a resolution of 864×3 and corresponding high Reynolds numbers are obtained. Visualizations of the resulting turbulent flow show that the turbulent activity is strongly correlated with low-pressure zones. This behavior of the pressure field is linked to the fact that the square vorticity is spatially more concentrated than the energy dissipation. Author

A92-15657 FILM COOLING RESEARCH ON THE ENDWALL OF A TURBINE NOZZLE GUIDE VANE IN A SHORT DURATION ANNULAR CASCADE. I - EXPERIMENTAL TECHNIQUE AND RESULTS

S. P. HARASGAMA and C. D. BURTON (Royal Aerospace Establishment, Propulsion Dept., Farnborough, England) *ASME, International Gas Turbine and Aeroengine Congress and Exposition*, 36th, Orlando, FL, June 3-6, 1991. 8 p. refs
(ASME PAPER 91-GT-252)

Heat transfer and aerodynamic measurements have been made on the endwalls of an annular cascade of turbine nozzle guide vanes in the presence of film cooling. The results indicate that high levels of cooling effectiveness can be achieved on the endwalls of turbine nozzle guide vanes (NGV). The NGV were operated at the correct engine nondimensional conditions of Reynolds number, Mach number, gas-to-wall temperature ratio and gas-to-coolant density ratio. Author

A92-15667 DISCHARGE COEFFICIENTS OF COOLING HOLES WITH RADIUSSED AND CHAMFERED INLETS

N. HAY and A. SPENCER (Nottingham, University, England) *ASME, International Gas Turbine and Aeroengine Congress and Exposition*, 36th, Orlando, FL, June 3-6, 1991. 7 p. refs
(ASME PAPER 91-GT-269)

The flow of cooling air within the internal passages of gas turbines is controlled and metered using holes in disks and casings. The effects of inlet radiussing and chamfering of these holes on the discharge coefficient are discussed. Experimental results for a range of radiussing and chamfering ratios for holes of different length to diameter ratios are presented, covering the range of pressure ratios of practical interest. The results indicate that radiussing and chamfering are both beneficial in increasing the discharge coefficient. Increases of 10-30 percent are possible. Chamfered holes give the more desirable performance characteristics in addition to being easier to produce than radiussed holes. Author

A92-15722 A SIMPLE MODEL TO SIMULATE SUBSONIC INTAKES AND PROPELLING NOZZLES OF AIRCRAFT GAS TURBINE ENGINES

I. H. ISMAIL and F. S. BHINDER (Hatfield Polytechnic, England) *ASME, International Gas Turbine and Aeroengine Congress and Exposition*, 36th, Orlando, FL, June 3-6, 1991. 6 p. refs
(ASME PAPER 91-GT-392)

The subsonic intake and the propelling nozzle of aircraft gas turbine engines are modeled for purposes of simulation. Each component is considered as a variable-area duct which is divided into a number of elemental sections. Flow properties are calculated in a step-by-step manner in each section, taking into account friction and area changes. The underlying theory of the model and a brief description of the computer program are given. The program has been written in FORTRAN 77, and runs on IBM AT or compatible microcomputers. Author

A92-15822 SPURIOUS, ZERO-TH-ORDER ENTROPY GENERATION ALONG A KINKED WALL

ERIC VAN DER MAAREL and BARRY KOREN (Center for Mathematics and Computer Science, Amsterdam, Netherlands) *International Journal for Numerical Methods in Fluids* (ISSN

0271-2091), vol. 13, Nov. 20, 1991, p. 1113-1129. Research supported by ESA. refs
Copyright

Numerical entropy generation is studied in the case of steady, subsonic Euler flow along a kinked solid wall. For a standard upwind finite volume discretization the numerical entropy error, a component of the global discretization error, appears to be zeroth-order in mesh size. Two possible causes of the zeroth-order entropy error are studied. First an investigation is made of the local truncation error on a kinked grid. Although this error also appears to be zeroth-order in the neighborhood of the kink, it probably does not cause the zeroth-order entropy error. Next a study is made of the existence of a singularity in the exact solution. Probably, the Euler flow solution is singular at the kink in the wall. The form of this likely singularity is unknown. Therefore, the construction of a computational method which uses a priori knowledge about the singularity is not possible. Finally, it is shown by numerical experiments that the subsonic Euler flow along a kinked wall still can be computed with vanishing entropy errors by using an appropriate sequence of continuously curved walls which converge to the kinked wall in the limit of zero mesh width.

Author

A92-16032
THE LINEAR INVISCID SECONDARY INSTABILITY OF LONGITUDINAL VORTEX STRUCTURES IN BOUNDARY LAYERS

PHILIP HALL (Manchester, Victoria University, England) and NICOLA J. HORSEMAN (Exeter University, England) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 232, Nov. 1991, p. 357-375. Research supported by SERC and USAF. refs
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The inviscid instability of a longitudinal vortex structure within a steady boundary layer is investigated. The instability has wavelength comparable with the boundary-layer thickness so that a quasi-parallel approach to the instability problem can be justified. The generalization of the Rayleigh equation to such a flow is obtained and solved for the case when the vortex structure is induced by curvature. Two distinct modes of instability are found; these modes correspond with experimental observations on the breakdown process for Goertler (1940) vortices.

Author

A92-16043
VORTEX INSTABILITIES IN THREE-DIMENSIONAL BOUNDARY LAYERS - THE RELATIONSHIP BETWEEN GOERTLER AND CROSSFLOW VORTICES

ANDREW P. BASSOM (Exeter, University, England) and PHILIP HALL (Manchester, Victoria University, England) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 232, Nov. 1991, p. 647-680. Research supported by SERC and USAF. refs
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The inviscid and viscous stability problems are addressed for a boundary layer which can support both Goertler and crossflow vortices. The change in structure of Goertler vortices is found when the parameter representing the degree of three-dimensionality on the basic boundary-layer flow under consideration is increased. It is shown that crossflow vortices emerge naturally as this parameter is increased and ultimately become the only possible vortex instability of the flow. It is shown conclusively that, at sufficiently large values of the crossflow, there are no unstable Goertler vortices present in a boundary layer which, in the zero-crossflow case, is centrifugally unstable. The results suggest that, in many practical applications, Goertler vortices cannot be a cause of transition because they are destroyed by the three-dimensional nature of the basic state. In swept-wing flows the Goertler mechanism is probably not present for typical angles of sweep of about 20 deg.

Author

A92-16089

THREE-DIMENSIONAL CALCULATIONS OF REACTIVE FLOWS IN AIRCRAFT COMBUSTION CHAMBERS PERFORMED USING TWO COMBUSTION MODELS [CALCULS TRIDIMENSIONNELS D'ECOULEMENTS REACTIFS DANS LES CHAMBRES DE COMBUSTION AERONAUTIQUES EFFECTUES A L'AIDE DE DEUX MODELES DE COMBUSTION]

FABIENNE PIT, HELENE TIGHTINSKY, PASCALE GILBANK, and FRANCIS DUPOIRIEUX (ONERA, Chatillon, France) (NATO, AGARD, Conference, 77th, San Antonio, TX, May 27-31, 1991) ONERA, TP no. 1991-110, 1991, 16 p. In French. Research supported by SNECMA and DRET. refs
(ONERA, TP NO. 1991-110)

Some 3D calculations have been conducted to predict the reactive flow in aircraft combustion chambers. Two types of combustion models are used. The first model is based on the hypothesis of fast chemistry that can take into account some aspects of the chemical kinetics through an ignition delay. The second, the Lagrangian-Eulerian PEUL model can deal directly with the Arrhenius laws by means of the IEM (interaction by exchange with the mean) submodel and therefore does not require the fast reaction hypothesis. It is demonstrated that the models can be used to analyze 3D turbulent reactive flows in aircraft chambers.

R.E.P.

A92-16114

BEHAVIOR OF A SUSPENSION IN THE PRESENCE OF A POTENTIAL VORTEX [COMPOTEMENT D'UNE SUSPENSION EN PRESENCE D'UN TOURBILLON IRRIGATIONNEL]

R. PRUD'HOMME (CNRS, Laboratoire d'Aerothermique, Meudon, France) and E. DODEMAND (ONERA, Chatillon, France) (Congres de Mecanique, 10th, Paris, France, Sept. 2-6, 1991) ONERA, TP no. 1991-140, 1991, 5 p. In French. refs
(ONERA, TP NO. 1991-140)

The basic equations for suspensions are written, assuming that the carrying fluid is isothermal and incompressible and that the particles occupy a negligible volume. The particles are assumed to be nondeformable, spherical, and of the same diameter. The velocity field of the particles and their trajectories are determined, and the evolution of the particle density is investigated. The results are of interest in connection with studies of the sudden condensation of a saturated vapor in vortex flow and the seeding of a turbulent flow in laser anemometry.

L.M.

A92-16229

ASYMPTOTIC TECHNIQUES FOR THE ANALYSIS OF FLUID SYSTEMS [LAS TECNICAS ASINTOTICAS EN EL ANALISIS DE SISTEMAS FLUIDOS]

AMABLE LINAN (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) *Ingenieria Aeronautica y Astronautica* (ISSN 0020-1006), no. 325, 1991, p. 3-14. In Spanish. refs
Copyright

Simplified descriptions of complex fluid systems with disparate scales are facilitated by order-of-magnitude estimates and asymptotic methods. The fluid system is divided into several subregions that can be understood with less complex equations of movement and of contour conditions. The movement of a liquid from a container through a pipe with a constant section is examined theoretically with attention given to specific regions of flow. The flux in the entrance region is examined for Reynolds numbers much greater than 1, and both the accommodation zone and the discharge from the container are analyzed. The equations of each region describe the contour conditions which can be used to couple the equations of neighboring regions. Distinct scales of flow are identified in each example that permit the problem to be simplified and described.

C.C.S.

A92-16455

VISCOUS-INVISCID INTERACTION DUE TO THE FREEZING OF A LIQUID FLOWING ON A FLAT PLATE

FRANCISCO J. HIGUERA (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) *Physics of Fluids A* (ISSN

0899-8213), vol. 3, Dec. 1991, p. 2875-2886. Research supported by DGICYT. refs
Copyright

The solidification of a liquid flowing along a flat plate whose temperature presents a step reduction from a value above to a value below the melting temperature of the liquid is shown to promote a viscous-inviscid interaction region. The structure of the flow in this region and the growth of the solid phase crust above the plate are described in the limit of high Reynolds numbers using triple-deck theory. Boundary-layer separation, which is a regular process in the framework of triple-deck theory, is shown to occur under appropriate conditions, namely for severe plate temperature reductions leading to thick solid crusts. A simplified approximate method is introduced to deal with these separated flows. Author

A92-17432

A 1D EXACT TREATMENT OF SHOCK WAVES WITHIN SPECTRAL METHODS IN PLANE GEOMETRY

SILVANO BONAZZOLA and JEAN-ALAIN MARCK (Paris, Observatoire, Meudon, France) Journal of Computational Physics (ISSN 0021-9991), vol. 97, Dec. 1991, p. 535-552. refs
Copyright

A high-accuracy numerical technique is presented which employs two moving grids, respectively before and after the shock formation, to solve 1D Euler equations that are coupled with the transport equations for the entropy and the chemical abundances in cases with and without shock formation. Chebyshev polynomial series are used to expand quantities on both sides of the matching point, and Rankine-Hugoniot conditions are used to ascertain the shock velocity after shock formation. Illustrative results are presented. O.C.

A92-19964

ASYMMETRIC OSCILLATIONS IN THERMOSOLUTAL CONVECTION

D. R. MOORE (Imperial College of Science, Technology, and Medicine, London, England), N. O. WEISS, and J. M. WILKINS (Cambridge, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 233, Dec. 1991, p. 561-585. refs
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Thermosolutal convection provides a testbed for applications of nonlinear dynamics to fluid motion. If the ratio of solutal to thermal diffusivity is small and the solutal Rayleigh number $R(S)$ is large, instability sets in at a Hopf bifurcation as the thermal Rayleigh number $R(T)$ is increased. For two-dimensional convection in a rectangular box, the fundamental mode is a single roll with point symmetry about its axis. The symmetries of periodic and steady solutions form an 8th-order group with invariant subgroups that describe pure single-roll and multiroll solutions. A systematic numerical investigation reveals a rich variety of spatiotemporal behavior in the regime where the value of $R(T)/R(S)$ is greater than 0 but much less than $R(S)$. Point symmetry is broken and there is a branch of spatially asymmetric periodic solutions. These mixed-mode oscillations lose their temporal symmetry in a subsequent bifurcation, followed eventually by a transition to chaos. Author

A92-19967

FINAL EQUILIBRIUM STATE OF A TWO-DIMENSIONAL SHEAR LAYER

J. SOMMERIA, C. STAQUET (Lyon, Ecole Normale Supérieure, France), and R. ROBERT Journal of Fluid Mechanics (ISSN 0022-1120), vol. 233, Dec. 1991, p. 661-689. refs
(Contract NSF OCE-89-16009)
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A new statistical theory of organized structures in 2D turbulence is tested by direct numerical simulations of the Navier-Stokes equations, using a pseudospectral method. The theory is applied to the final equilibrium state of a shear layer evolving from a band of uniform vorticity; a relationship between vorticity and stream function is predicted by maximizing an entropy with the constraints due the constants of the motion. A partial differential equation for

the stream function is then obtained. In the particular case of a very thin initial vorticity band, the Stuart's vortices appear to be a family of solutions for this equation. In more general cases, the theory is tested by inspecting the relationship between stream function and vorticity in the final equilibrium state of the numerical computation. An excellent agreement is obtained in regions with strong vorticity mixing. However, local equilibrium is obtained before a complete mixing can occur in the whole fluid domain. Author

A92-20511

FRACTAL DIMENSIONS AND SPECTRA OF INTERFACES WITH APPLICATION TO TURBULENCE

J. C. VASSILICOS and J. C. R. HUNT (Cambridge, University, England) Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences (ISSN 0080-4630), vol. 435, no. 1895, Dec. 9, 1991, p. 505-534. refs
(Contract CEC-ST2J-0029-1-F)
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An analysis is presented of any convoluted surface in two or three dimensions which has a self-similar structure, and which may simply be defined as a mathematical surface or as an interface where there is a sharp change in the value of a scalar field. A distinction is drawn between two types of self-similarity which is pertinent for problems of interfaces in fluid flows: a local and a global self-similarity. It is demonstrated that interfaces with a localized self-similar structure around accumulation points, such as spirals, may have noninteger capacities $D(K)$ and $D\text{-prime}(K)$ even though their Hausdorff dimension is integer and equal to the topological dimension of the surface. It is explained how the same surface can have different values of $D(K)$ and $D\text{-prime}(K)$ over different asymptotic ranges of epsilon. P.D.

A92-20724

AN INFLUENCE-MATRIX FORMULATION OF THE NAVIER-STOKES EQUATIONS IN VELOCITY-VORTICITY VARIABLES FOR INCOMPRESSIBLE FLOWS [UNE FORMULATION PAR MATRICE D'INFLUENCE DES EQUATIONS DE NAVIER-STOKES INCOMPRESSIBLES EN VARIABLES VITESSE-TOURBILLON]

JEAN-LUC GUERMOND (CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences pour l'Ingenieur, Orsay, France) and ANTOINE SELLIER (Ecole Polytechnique, Palaiseau, France) Académie des Sciences (Paris), Comptes Rendus, Serie II - Mécanique, Physique, Chimie, Sciences de la Terre et de l'Univers (ISSN 0764-4450), vol. 313, no. 13, Dec. 19, 1991, p. 1507-1512. In French. refs
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An influence-matrix formulation is proposed to uncouple the vorticity and velocity problems in the framework of a 3D velocity-vorticity formulation of the Navier-Stokes equations for incompressible flows. Multiply connected domains are considered. L.M.

A92-21306

AN APPROXIMATE METHOD FOR TREATING A TURBULENT BOUNDARY LAYER WITH SYMMETRY OF REVOLUTION [SUR UNE METHODE APPROCHEE DE TRAITER LA COUCHE LIMITE TURBULENTE A SYMETRIE DE REVOLUTION]

R. ASKOVIĆ (Valenciennes et Hainaut-Cambresis, Université, Valenciennes, France) Revue Roumaine des Sciences Techniques, Serie de Mécanique Appliquée (ISSN 0035-4074), vol. 36, May-Aug. 1991, p. 171-186. In French. refs

An approximate method for handling a turbulent boundary layer with symmetry of revolution is proposed which is based on a variant of semiempirical phenomenological theory developed for the two-dimensional analogue case. The method relies on an analogy with rheological laws used in the study of flows of non-Newtonian liquids with nonlinear viscosity. First results obtained using this method to calculate a turbulent boundary layer on a sphere are encouraging. L.M.

A92-21461

EMPIRICAL DETERMINATION OF UNIVERSAL MULTIFRACTAL EXPONENTS IN TURBULENT VELOCITY FIELDS

F. SCHMITT, D. LAVALLEE, D. SCHERTZER (Météorologie Nationale, Centre National de Recherche Météorologique, Paris, France), and S. LOVEJOY (McGill University, Montreal, Canada) *Physical Review Letters* (ISSN 0031-9007), vol. 68, Jan. 20, 1992, p. 305-308. refs

(Contract DE-FG03-90ER-61062)

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It is now apparent that the two principal models of turbulence (the 'beta' and 'lognormal' models) are the extremes of a continuous family of (stable, attractive, hence 'universal') multifractals characterized by Levy indices $\alpha = 0$ and 2 , respectively. Using a technique called 'double trace moment analysis', and turbulent velocity data, α of about 1.3 ± 0.1 is empirically obtained. As has long been suspected, turbulence really is 'in between' the Beta and lognormal models. This describes the entire hierarchy of singularities of the Navier-Stokes equations. Author

A92-21505

MODEL AND COMPUTATION OF DISCRETE JETS IN CROSSFLOW

F. LEBOEUF, G.-P. HUANG, P. KULISA, and G. PERRIN (Lyon, Ecole Centrale, Ecully, France) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 10, no. 6, 1991, p. 629-650. refs

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A new model is presented for the simulation of discrete three dimensional turbulent jets introduced into a crossflow. The transport phenomena between the jet and the external flow are analyzed, leading to the definition of particular closure relationships associated with the transfer between external fluid and the jet. In a curvilinear coordinate system, the conservation equations are integrated over the transverse jet section. This model is capable of producing global and local jet information. The jet induced velocity field is computed by the use of singularities: source-sink, transformed doublet, and the vortices calculated from a transport equation. The interaction of multiple jet is simulated by introducing the velocity field induced by the adjacent and upstream jets. Comparisons between the theory and experiments, for the different jet configurations, show satisfactory agreement. Author

A92-21506

ON THE ARNOL'D STABILITY CRITERION FOR STEADY-STATE FLOWS OF AN IDEAL FLUID

P. ROUCHON (Paris, Ecole des Mines, France) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 10, no. 6, 1991, p. 651-661. refs

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A sufficient nonlinear stability criterion, proposed by Arnol'd (1965) for smooth stationary solutions of the incompressible Euler equations, is considered. It is shown that a method for obtaining steady-state flows (Vallis et al., 1989) that satisfies automatically the Arnol'd stability criterion cannot be applied to 3D perturbations, but only to 2D ones. The 3D stability of nonzero stationary flows cannot be deduced from this criterion. O.G.

A92-21613

THE MULTIPARAMETER METHOD OF A BOUNDARY LAYER ON THIN BODIES OF REVOLUTION [MNOGOPARAMETRICHESKII METOD POGRANICHNOGO SLOIA NA TONKIKH TELAKH VRASHCHENIIA]

S. T. KOSTICH (Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Nov.-Dec. 1991, p. 22-27. In Russian. refs

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The problem of a laminar and stationary boundary layer of an incompressible fluid on elongated thin bodies of revolution in axisymmetric flow is analyzed for the case where the ratio of the boundary layer thickness to the radius of the body cross section

cannot be neglected. For this purpose, the equation of a boundary layer on thin bodies of revolution is generalized using the method of Loitsianskii (1978). Numerical results are presented in graphic form. V.L.

A92-21703

CALCULATION OF FLUID FLOWS WITH STAGGERED AND NONSTAGGERED CURVILINEAR NONORTHOGONAL GRIDS. I - THE THEORY. II - A COMPARISON

M. C. MELAAEN (Foundation for Scientific and Industrial Research, Trondheim, Norway) *Numerical Heat Transfer, Part B: Fundamentals* (ISSN 1040-7790), vol. 21, Jan.-Feb. 1992, p. 1-19, 21-39. Research supported by NTNF and Norwegian National Program for Utilization of Natural Gas. refs

Copyright

Tensor calculus is presently employed to furnish both necessary coordinate and velocity transformations in the present use of two different finite-volume methods for discretization of conservation equations in 3D curvilinear nonorthogonal coordinates. While one method is based on the nonstaggered grid arrangement and employs Cartesian velocity components as dependent variables in the momentum equations, the other combines a staggered grid arrangement with physical covariant velocity projections in a locally fixed coordinate system. In the second part of this work, a comparative evaluation of the two methods indicates that while results of comparable accuracy are achieved after a similar number of iterations, the staggered method may be recommended for curvilinear nonorthogonal coordinate problems due to its reduced memory and computational requirements. O.C.

A92-21923

APPLICATION OF HOLOMORPHIC VECTORS THEORY IN THREE-DIMENSIONAL POTENTIAL FLOW PROBLEM

ZDENEK SKODA *Zprava VZLU*, no. Z-63, 1991, 9 p. refs

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A new theoretical approach to a 3D flow problem which is based on holomorphic vectors is presented. This approach makes it possible to obtain the velocity field without numerical differentiation and to keep the number of equations equal to the number of panels. The flow is described through holomorphic vectors and Cauchy-type 3D integrals. Properties of the latter are defined and used to find a solution by an iterative procedure applied to a single Fredholm integral equation. Expressions for evaluation of the velocity field are also obtained. O.G.

A92-22124

A THEORETICAL APPROACH TO IMPULSIVE MOTION OF VISCOUS LIQUID BRIDGES

J. MESEGUER, J. M. PERALES (Madrid, Universidad Politecnica, Spain), and N. A. BEZDENNEZHNYKH (AN SSSR, Institut Mekhaniki Sploshnykh Sred, Perm, USSR) *Microgravity Quarterly* (ISSN 0958-5036), vol. 1, no. 4, 1991, p. 215-219. Research supported by CICYT. refs

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This paper deals with the dynamics of isothermal, axisymmetric, viscous liquid columns held by capillary forces between two circular, concentric, solid disks. The transient response of the bridge to an excitation consisting of a small change in the value of the acceleration acting along its axis has been solved by using a linearized one-dimensional Cosserat model, which includes viscosity effects. The main hypothesis of this model is that the axial velocity is considered constant in each section of the liquid bridge. The analysis has been performed by using the Laplace transform. Author

A92-22346

PARALLEL ALGORITHMS FOR PANEL METHODS

TIM DAVID and GRAHAM BLYTH (Leeds, University, England) *International Journal for Numerical Methods in Fluids* (ISSN 0271-2091), vol. 14, Jan. 15, 1992, p. 95-108. refs

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A parallel algorithm for the solution of potential flow problems using the panel method of Hess and Smith and conjugate and

bi-conjugate gradient techniques is presented. Analysis of the parallelism for the matrix solvers shows the algorithms to have scalable properties as the problem size grows indefinitely large. Speed-up and efficiency values are presented along with experimental and theoretical values for the optimum number of processors for maximum speed-up. It is envisaged that the parallel techniques presented here have applications using other boundary integral methods for solving engineering problems of a more complex nature. Author

A92-22475

AN ITERATIVE METHOD FOR COUPLED SOLVING OF 2D UNSTEADY NAVIER-STOKES EQUATIONS

O. P. ILIEV (Bulgarian Academy of Sciences, Institute of Mathematics, Sofia, Bulgaria) and M. M. MAKAROV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) B'lgarska Akademiia na Naukite, Dokladi (ISSN 0861-1459), vol. 44, no. 7, 1991, p. 21-24. refs

(Contract NSF INT-89-14472)

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The iterative method permits the coupled solving of the equations in the psi-omega formulation and is applied to the problem of lid-driven cavity flow. The stationary solution of the problem is employed for convenience, and the coupled and decoupled solutions are compared to examine restrictions in the time step. The numerical technique can be used to solve the coupled 2D unsteady Navier-Stokes equations by using implicit-difference schemes with time steps and no restrictions for all Reynolds numbers. C.C.S.

A92-22624

NUMERICAL COMPUTATION OF INTERNAL AND EXTERNAL FLOWS. VOL. 2 - COMPUTATIONAL METHODS FOR INVISCID AND VISCOUS FLOWS

CHARLES HIRSCH (Brussel, Vrije Universiteit, Brussels, Belgium) Chichester, England and New York, John Wiley & Sons, 1990, 708 p. refs

(ISBN 0-471-92351-6) Copyright

Applications of computational methods to the problems of fluid dynamics are examined with attention given to numerical techniques and algorithms for implementation topics such as boundary conditions. The fundamental problems of turbulence are addressed within the context of modeling the phenomena by means of the Reynolds-averaged approximation. The full-potential model is addressed which represents the simplest inviscid approximation emphasizing the treatment of transonic situations. The Euler equations are described in detail, and reviews are given of the discretization methods for the Navier-Stokes equations. It is recommended that to develop a code for CFD it is most effective to consider as many variants as possible of time-integration methods, boundary conditions, and control mechanisms for nonlinear instabilities. The present publication is of significant interest to the fields of industrial fluid dynamics and aeronautics as well as general research in CFD. C.C.S.

A92-23252

A FIRE FIELD MODEL IMPLEMENTED IN A PARALLEL COMPUTING ENVIRONMENT

C. S. IEROTHEOU and E. R. GALEA (Thames Polytechnic, London, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 14, Jan. 30, 1992, p. 175-187. Research supported by Civil Aviation Authority and SERC. refs

Copyright

This paper describes the implementation of a fire model in the parallel computing environment offered by multiple transputers. The fire model is built into the general purpose SIMPLE-based CFD code HARWELL-FLOW3D. The technique of domain decomposition has been applied to convert the conventional serial version of FLOW3D into a code capable of efficiently utilizing an arbitrary number of transputers. Fire simulations consisting of up to 24,000 computational cells are performed on parallel systems with up to 15 processors. The run time for this simulation has been reduced from over 4 days on a single processor to just

over 8 h on the 15-processor system. An interactive graphics system has also been developed which runs in parallel with the main computations. Author

A92-23256

A SIMPLE PROOF OF EXISTENCE OF WEAK AND STATISTICAL SOLUTIONS OF NAVIER-STOKES EQUATIONS

MAREK CAPINSKI and NIGEL CUTLAND (Hull, University, England) Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences (ISSN 0962-8444), vol. 436, no. 1896, Jan. 8, 1992, p. 1-11. Research supported by SERC. refs

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The Galerkin approximation to the Navier-Stokes equations in dimension N, where N is an infinite nonstandard natural number, is shown to have standard part that is a weak solution. This construction is uniform with respect to nonstandard representation of the initial data, and provides easy existence proofs for statistical solutions. Author

A92-23289

ADDING THE TIME-DEPENDENT TERMS TO A SEGREGATED FINITE ELEMENT SOLUTION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS

C. T. SHAW (Warwick, University, Coventry, England) Engineering Computations (ISSN 0264-4401), vol. 8, Dec. 1991, p. 305-316. refs

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To-date, several segregated finite element algorithms have been proposed that solve the Navier-Stokes equations. These have considered only steady-state cases. This paper describes the addition of the time-dependent terms to one such segregated solution scheme. Several laminar flow examples have been computed and comparisons made to predictions obtained with both finite difference and finite volume solution schemes. The finite element results compare very well with the results from the other schemes, both in terms of accuracy and the qualitative behavior of the iterative schemes. Author

A92-23292

THE ROLE OF DISSIPATION MECHANISMS IN THE NONLINEAR DYNAMICS OF UNSTABLE BAROCLINIC WAVES

P. KLEIN (Institut Francais de Recherche pour l'Exploitation de la Mer, Plouzane, France) and J. PEDLOSKY (Woods Hole Oceanographic Institution, MA) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 49, Jan. 1, 1992, p. 29-48. Research supported by NSF. refs

Copyright

The effect of three different parameterizations of dissipation on the nonlinear dynamics of unstable baroclinic waves is studied. The model is the two-layer f-plane model and the dynamics is quasi-geostrophic. The dissipation mechanisms are (1) dissipation due to Ekman layers at the horizontal boundary surface, (2) the addition of interfacial Ekman friction, or (3) dissipation proportional to the perturbation potential vorticity. As anticipated by weakly nonlinear theory, a strong effect on the nonlinear amplitude dynamics is found for supercriticalities as large as four times the threshold value for instability. The use of interfacial friction or potential vorticity damping expunges the vacillating behavior common to the system with type I dissipation. At high supercriticality, a barotropic vacillation involving the mean flow and harmonics of the fundamental is superimposed on the basic baroclinic wave dynamics. Examination of the critical transition for the emergence of the barotropic oscillation reveals that the enhanced linear instability of the higher harmonics is responsible for the self-sustained vacillation. Author

A92-24429

A DISCONTINUOUS H-P GALERKIN APPROXIMATION OF POTENTIAL FLOWS

JEAN-LUC GUERMOND (CNRS, Laboratoire d'Informatique pour la Mecanique et les Sciences pour l'Ingenieur, Orsay, France) and SOPHIE FONTAINE (Bassin d'Essais des Carenes, Paris,

France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1991, p. 37-49. refs
(Contract DRET-90-1047)
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A discontinuous h-p Galerkin method is presented for solving steady potential flows about nonlifting bodies. The problem is solved by means of the boundary integral equation formulation. The body surface panels do not have to be structured, so it can be produced by a standard CAD system. Furthermore, numerical quadratures for calculating single and double-layer potentials are given. More generally, these numerical quadratures are shown to be useful for evaluating surface integrals involving kernels which are pseudo-homogeneous of minus-one degree. Author

A92-24430

MEASUREMENT OF CONVECTIVE HEAT-TRANSFER COEFFICIENTS IN WIND TUNNELS USING PASSIVE AND STIMULATED INFRARED THERMOGRAPHY

D. L. BALAGEAS, D. M. BOSCHER, A. A. DEOM, J. FOURNIER, and G. GARDETTE (ONERA, Chatillon, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 4, 1991, p. 51-72. Research supported by DRET. refs
Copyright

Infrared thermography is a means of visualization in common use now among workers in aerodynamics. Progress in infrared scanner technology makes it possible to determine transient surface-temperature distributions on wind tunnel models with good precision. By combining this technique with heat transfer analysis and modeling, the heat transfer coefficient distribution can be determined quantitatively. Two different ways are presented here for measuring the heat transfer coefficient using IRT: passive and active (or stimulated) thermography. A practical application of the two techniques is presented which concerns a missile model in a supersonic wind tunnel. Comparisons are made between passive and active measurements, and between experiment and theory. Author

A92-24751

THE ROLL-UP OF VORTICITY STRIPS ON THE SURFACE OF A SPHERE

DAVID G. DRITSCHER (Cambridge, University, England) and LORENZO M. POLVANI (Columbia University, New York) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 234, Jan. 1992, p. 47-69. Research supported by SERC and NSF. refs
Copyright

Conditions for the stability of strips or filaments of vorticity on the surface of a sphere are derived using a linear stability analysis of the simplest vorticity configuration, namely, a zonal band of uniform vorticity located in equilibrium between two latitudes. The fully developed stages of the instabilities are illustrated by direct numerical simulation. Barotropic flows on the sphere are found to have a more pronounced tendency for producing small, long-lived vortices, especially in equatorial and midlatitude regions, than was previously anticipated from the theoretical results for planar flows. The curvature of the sphere's surface weakens the interaction between different parts of the flow, enabling these parts to behave in relative isolation. O.G.

A92-24758

THE JET EDGE-TONE FEEDBACK CYCLE - LINEAR THEORY FOR THE OPERATING STAGES

D. G. CRIGHTON (Cambridge, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 234, Jan. 1992, p. 361-391. refs
(Contract N00014-81-G-0010; N00014-86-G-0066)
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A linear analytical model for predicting the frequency characteristics of the discrete oscillations of the jet-edge feedback cycle is presented. The jet is idealized as a top-hat jet with uniform flow between two vortex-sheet shear layers, which permits analytical investigation of the jet coupling to the nozzle and the jet interaction with the downstream splitter plate. The interaction of a flat plate inserted along the centerline of the jet with the

splitter plate produces an irrotational feedback field which, near the nozzle exit, is a periodic transverse flow producing singularities at the nozzle lips. Vortex shedding is assumed to occur, alleviating the singularities and allowing a trailing-edge Kutta condition to be satisfied. The Kutta condition is claimed to be the phase-locking criterion. The shed vorticity develops into a sinuous spatial instability, and the cycle of events is repeated periodically. Physical processes are solved in an appropriate asymptotic sense by Wiener-Hopf methods. O.G.

A92-24760

COUPLED BUOYANCY AND MARANGONI CONVECTION IN ACETONE - EXPERIMENTS AND COMPARISON WITH NUMERICAL SIMULATIONS

D. VILLERS and J. K. PLATTEN (Mons, Universite de l'Etat, Belgium) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 234, Jan. 1992, p. 487-510. refs
(Contract FNRS-1,50101,89F)
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This paper presents a study of the convection in acetone due jointly to the thermocapillary (Marangoni) and thermogravitational effects. The liquid (acetone) is submitted to a horizontal temperature difference. Experiments and numerical simulations both show the existence of three different states: monocellular steady states, multicellular steady states and spatio-temporal structures. The results are discussed and compared with the linear stability analysis of Smith & Davis (1983). Author

A92-26220

RECENT PROGRESS IN REACTIVE FLOW COMPUTATIONS

B. LARROUTOUROU (INRIA, Valbonne, France) IN: Computing methods in applied sciences and engineering; Proceedings of the 9th International Conference, Paris, France, Jan. 29-Feb. 2, 1990. Philadelphia, PA, Society for Industrial and Applied Mathematics, 1990, p. 249-272. refs
Copyright

Some recent progress concerning a family of numerical schemes for the numerical simulation of a multidimensional flow of a reactive perfect or real gaseous mixture is reported. These schemes use a second-order accurate upwind approximation, and operate unstructured finite-element meshes. In particular, they have the property of preserving the maximum principle (and in particular the positivity) for the mass fractions of all species in the gaseous mixture. These schemes have been used for a number of reactive flows at various regimes, ranging from highly subsonic to hypersonic flows. Author

A92-26221

NUMERICAL SIMULATION OF TRANSITION TO TURBULENCE IN FREE-SHEAR LAYERS

M. LESIEUR, P. COMTE, Y. FOUILLET, M. A. GONZE, and X. NORMAND (Grenoble, Institut de Mecanique; Grenoble, Institut National Polytechnique; Grenoble I, Universite, France) IN: Computing methods in applied sciences and engineering; Proceedings of the 9th International Conference, Paris, France, Jan. 29-Feb. 2, 1990. Philadelphia, PA, Society for Industrial and Applied Mathematics, 1990, p. 273-288. Research supported by CNES and Dassault Aviation. refs
(Contract DRET-88-150)
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The transition to turbulence in various free-shear layers has been studied using 2D and 3D Navier-Stokes equations. Cases under consideration include a 2D mixing layer with periodic boundary conditions in the flow direction; 2D spatially developing mixing layers, wakes and jets; a 2D compressible mixing layer; and a 3D incompressible temporal mixing layer and wake. It is shown that, in the 2D case, the coherent structures develop from the Kelvin-Helmholtz instability, undergo successive pairings, and are unpredictable. The compressible calculations show an inhibition of the instability above a convective Mach number of 0.6. In the incompressible 3D case, direct numerical simulations at high resolution and low Reynolds number make it possible to show how hairpin vortices are strained longitudinally in cases of both

the mixing layers and the wake. High Reynolds numbers can be reached through a spectral subgrid-scale eddy-viscosity. The coherent structures are shown to survive in this case and the kinetic energy is shown to cascade toward the subgrid scales along a Kolmogorov $k \exp -5/3$ spectrum. O.G.

A92-26269*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ON THE NUMERICAL TREATMENT OF NONLINEAR SOURCE TERMS IN REACTION-CONVECTION EQUATIONS

A. LAFON (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) and H. C. YEE (NASA, Ames Research Center, Moffett Field, CA) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 23 p. Research supported by DRET. refs (AIAA PAPER 92-0419)

The objectives of this paper are to investigate how various numerical treatments of the nonlinear source term in a model reaction-convection equation can affect the stability of steady-state numerical solutions and to show under what conditions the conventional linearized analysis breaks down. The underlying goal is to provide part of the basic building blocks toward the ultimate goal of constructing suitable numerical schemes for hypersonic reacting flows, combustions and certain turbulence models in compressible Navier-Stokes computations. It can be shown that nonlinear analysis uncovers much of the nonlinear phenomena which linearized analysis is not capable of predicting in a model reaction-convection equation. Author

A92-26367

NUMERICAL FLOW VISUALIZATION OF HIGH REYNOLDS NUMBER RECIRCULATED FLOWS USING AN ANIMATION TECHNIQUE

ALAIN LESAIN (ONERA, Chatillon, France) and YVES GAGNON (Moncton, Universite, Edmundston, Canada) ONERA, TP no. 1991-215, 1991, 25 p. Research supported by NSERC and Universite de Moncton. refs (ONERA, TP NO. 1991-215)

Using numerical results of recirculated flows obtained by the random vortex method, this paper presents visualization of these flows using an animation technique. The flows simulated are high Reynolds number flows inside a two-dimensional channel that incorporates a sudden expansion in the form of a single step and a two-dimensional channel that incorporates a sudden expansion in the form of a double symmetrical step. The formulation and the algorithm of the fluid flow computations are first presented, followed by the general method and the algorithm used to generate a sequence of images representing the flow. Results are presented to show the ability of the technique. Author

A92-26386

MULTIGRID AND ADI TECHNIQUES TO SOLVE UNSTEADY 3D VISCOUS FLOW IN VELOCITY-VORTICITY FORMULATION

D. TROMEUR-DERVOIT (ONERA, Chatillon, France) and PHUOC L. TA (CNRS, Laboratoire d'Informatique pour la Mecanique et les Sciences pour l'Ingenieur; ONERA, Orsay, France) (Gesellschaft fuer Angewandte Mathematik und Mechanik, Workshop, Paris, France, June 12-14, 1991) ONERA, TP no. 1991-235, 1991, 13 p. Research supported by DRET. refs (ONERA, TP NO. 1991-235)

Multigrid and ADI methods were used to solve unsteady 3D Navier-Stokes equations in Velocity-Vorticity formulation, for the lid-driven cavity test case of spanwise aspect ratio equal to 3:1, at a Reynolds number Re equal to 3200. Results are given for the characteristic times $T = 50, 100, 200$. Author

A92-26409

LOCAL SOLUTION ACCELERATION METHOD FOR THE EULER AND NAVIER-STOKES EQUATIONS

D. DRIKAKIS and S. TSANGARIS (Athens, National Technical University, Greece) (ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990, Proceedings. Vol. 2, p. 1999-2011) AIAA Journal

(ISSN 0001-1452), vol. 30, Feb. 1992, p. 340-348. Previously cited in issue 09, p. 1380, Accession no. A91-24506. refs Copyright

A92-26967#

NUMERICAL SIMULATIONS OF FLOWS AROUND FLAME HOLDERS

X. S. BAI, L. FUCHS, and Y. LI (Royal Institute of Technology, Stockholm, Sweden) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 8 p. refs (Contract STU-89-2269)

(AIAA PAPER 92-0557) Copyright

The numerical simulations of turbulent flow around a flame holder model placed in a wind tunnel is presented. The calculations include both isothermal and reacting flows. The (cold) isothermal flow is modeled by Reynolds averaged Navier-Stokes N-S equations equipped with standard two-equation k -epsilon model and Large Eddy Simulations (LES). The (hot) reacting flow is calculated by a premixed flame model based on Magnussen's eddy dissipation concept, in addition to the N-S equations and k -epsilon equations. The system of equations is solved numerically on a system of global and locally refined grids, using a multigrid method. The results show that the numerical calculations compare well with the experimental results. Author

A92-27379

UNSTEADY THREE-DIMENSIONAL BENARD CONVECTION - LIGHT-SCATTERING, STATISTICS AND CHAOS

SUSAN C. RYRIE (Bristol, University, England) Fluid Dynamics Research (ISSN 0169-5983), vol. 9, Jan. 1992, p. 19-57. Research supported by SERC. refs Copyright

A pseudo-spectral code is used to simulate unsteady three-dimensional Benard convection in a fluid of moderate Prandtl number, $Pr = 10$. Periodic, quasi-periodic, and chaotic regimes are identified for Rayleigh numbers R in the range 40-75 R_c . Attention is focused on calculating experimentally measurable properties of the temperature field; the Nusselt number and the phase shift impressed on light shone through the fluid due to temperature-induced variations in the refractive index of the fluid. Statistical properties of these quantities are discussed for the three flow regimes. The horizontally averaged Nusselt number can show qualitatively different behavior from pointwise measurements of the phase-shift; in particular it is insensitive to the presence of traveling wave instabilities. Insufficient spatial resolution of the flow appears to suppress chaotic temporal behavior. Author

A92-27385

INTERNAL FLOW MODELLING OF VORTEX THROTTLES

Z. Y. YANG (Queen Mary and Westfield College, London, England), G. H. PRIESTMAN, and H. F. BOYSAN (Sheffield, University, England) Institution of Mechanical Engineers, Proceedings, Part C - Journal of Mechanical Engineering Science (ISSN 0954-4062), vol. 205, no. C6, 1991, p. 405-413. refs Copyright

A finite difference computer code has been used to predict highly swirling confined incompressible turbulent flow in vortex throttles. As turbulence can become highly anisotropic in such flow cases, both the widely used two-equation k -epsilon model and a Reynolds stress model have been used. The results have been compared with basic experimental data and the predicted flow structure within the throttles is related to the main design parameters. It has been found that the pressure drop across the vortex throttles occurs mainly through the axial port by dissipation of the high tangential velocity. Energy loss in the vortex chamber tends to reduce the vortex strength, lowering the tangential velocity and consequently reducing the pressure drop. Author

A92-27475

CELL VERTEX FINITE VOLUME DISCRETIZATIONS IN THREE DIMENSIONS

P. I. CRUMPTON and G. J. SHAW (Oxford, University, England) International Journal for Numerical Methods in Fluids (ISSN

0271-2091), vol. 14, March 15, 1992, p. 505-527. Research supported by SERC and British Aerospace, Ltd. refs
Copyright

The cell vertex method is generalized to three dimensions. It is proved that there exists a one-parameter family of eight-point three-dimensional methods with second-order truncation error on parallelepipeds. Using different triangulations of control volume faces, various finite volume methods are derived. Some of these are identified as members of the aforementioned one-parameter family and may be regarded as second-order upwind schemes. A Fourier analysis is used to investigate the spectral properties of these discretizations. Numerical experiments illustrate that second-order global accuracy is achieved on parallelepiped grids, as suggested by the theory. Randomly perturbed, stretched, sheared meshes are used to test these methods to destruction. It is found that upwinding improves both the accuracy on distorted meshes and the spectrum of the discretization. Author

A92-28061

USING RANKINE VORTICES TO MODEL FLOW AROUND A BODY OF REVOLUTION

B. S. TAYLOR (Portsmouth Polytechnic, England) and A. R. J. M. LLOYD (Defence Research Agency, Maritime Div., Gosport, England) AIAA Journal (ISSN 0001-1452), vol. 30, March 1992, p. 839-841. refs
Copyright

The techniques used in the SUBSIM mathematical model to represent the flow around a body-of-revolution at an angle of attack involve the representation of the measured vorticity contours by a series of discrete Rankine vortices. Attention is given to the condition for the vortices' merging, and expressions for the Rankine vortex image within the circular body are developed. Applications of these techniques are envisioned for submarines, airships, missiles, and offshore structures. O.C.

A92-28942

IMPINGING JETS IN CROSS-FLOW

K. KNOWLES, D. BRAY (Royal Military College of Science, Shrivenham, England), P. J. BAILEY (Logico Systems, Ltd., East Horsley, England), and P. CURTIS (British Aerospace /Military Aircraft/, Ltd., Kingston-upon-Thames, England) (Royal Aeronautical Society, International Powered Lift Conference, London, England, Aug. 29-31, 1990) Aeronautical Journal (ISSN 0001-9240), vol. 96, Feb. 1992, p. 47-56. refs
Copyright

The present investigation of flowfields generated by the impingement of single and twin jets in cross-flows gives attention to the ground vortex position-defining parameters of cross-flow/nozzle velocities ratio, cross-flow boundary layer thickness, nozzle height, nozzle pressure ratio, vector angle, and nozzle splay (with both fixed and moving ground-planes). The results obtained indicate that the ground vortex moves away from the nozzle centerline as the ratio of cross-flow velocity to nozzle exit velocity is decreased. The positional rate of change, however, depends on other parameters. Self-similarity laws are proposed for the ground vortex and wall jet. O.C.

A92-28950

VELOCITY CORRELATION IN ISOTROPIC TURBULENCE ACCORDING TO A MODIFIED OBUKHOV THEORY

I. BREVIK (Trondheim, University, Norway) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 2, 1992, p. 145-148. refs
Copyright

The second-order longitudinal correlation function for velocity in isotropic turbulence is treated with a hybrid model that does not predict discontinuous nonphysical behavior at high wave numbers. The modified Obukhov theory by Ellison (1962) is employed in the equilibrium range, and the interpolation formula by von Karman (1948) is used at lower wave numbers in the energy-containing range. The modified Obukhov treatment is shown to be suitable for the analysis of isotropic turbulence and accurately

predicts the behavior of phenomena observed in axisymmetric jets. C.C.S.

A92-28990

NUMERICAL SIMULATION OF TRIPOLAR VORTICES IN 2D FLOW

PAOLO ORLANDI (Roma I, Universita, Rome, Italy) and GERTJAN F. VAN HEIJST (Eindhoven University of Technology, Netherlands) Fluid Dynamics Research (ISSN 0169-5983), vol. 9, Feb. 1992, p. 179-206. refs
Copyright

The formation of a tripolar vortex in a two-dimensional flow is simulated numerically for two different cases, viz. the tripole arising from a collision of two Lamb dipoles, and the emergence of a tripole from an initially axisymmetric, unstable vortex. This latter situation was also considered in a laboratory experiment by van Heijst, Kloosterziel and Williams, and the numerical results show very good agreement with their observations, both qualitatively and quantitatively. Under certain conditions a higher wavenumber instability is found, resulting in a triangular vortex which itself turns out to be unstable. The results of the numerical simulation agree fairly well with laboratory observations of this higher-order instability scenario. Author

A92-29523

SIMULATION OF CONVECTIVE TEMPERATURE OSCILLATIONS IN PHASE-CHANGE PROCESSES

J. PRAZAK (Czech Technical University, Prague, Czechoslovakia) and J. PATEK (Czechoslovak Academy of Sciences, Institute of Thermomechanics, Prague, Czechoslovakia) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 35, Feb. 1992, p. 393-401. Research supported by Intercosmos Research Program. refs
Copyright

This work is directed toward numerical simulations of short time temperature oscillations in liquid during the melting and/or solidification processes. A new approach based on the time-dependent Navier-Stokes equation developed for this purpose is proposed. The method is further applied to three example situations showing that it is capable of handling complicated phase-change problems. The mechanism of origin of the temperature oscillations in the vortices interaction is demonstrated. Author

A92-29599#

THREE-DIMENSIONAL UNSTEADY FLOW CALCULATIONS IN BOTH INTAKE PORT AND COMBUSTION CHAMBER

J. Y. TU and L. FUCHS (Royal Institute of Technology, Stockholm, Sweden) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 11 p. refs
(Contract STU-89-02268)
(AIAA PAPER 92-0833) Copyright

A numerical scheme using overlapping grids and multigrid methods for calculations of three-dimensional unsteady flows in internal combustion engines is presented. The flow is modeled by the incompressible Navier-Stokes equations incorporating a k-epsilon turbulence model. The main feature of the present scheme is its extended flexibility to deal with three-dimensional complex multicomponent geometries. The multigrid method is used to accelerate the convergence of the numerical solver. A time-independent grid system is constructed for the moving piston in the engine. The flexibility and potential of the method has been demonstrated by calculating several cases which would be very difficult to be handled by other approaches. Results are compared with published numerical and experimental data. Author

A92-29649

NUMERICAL FLUID MECHANICS - INCOMPRESSIBLE FLOWS WITH COMPLEX BOUNDARIES [NUMERISCHE STROEMUNGSMECHANIK - INKOMPRESSIBLE STROEMUNGEN MIT KOMPLEXEN BERANDUNGEN]

BERNHARD E. SCHOENUNG (ABB Turbo Systems AG, Baden,

Switzerland) Berlin, Springer-Verlag, 1990, 321 p. In German. refs
(ISBN 3-540-53137-8) Copyright

An overview is presented of the state of the art in flow mechanical calculative methods which use geometrical coordinates. The topics addressed include: flow mechanical partial differential equations, behavioral equations, numerical methods for solving Navier-Stokes equations, discretization of the region to be calculated, ordering of variables, discretization of differential equations, coupled and uncoupled calculative methods, solution of algebraic systems of equations, 3D calculative methods for general curved coordinates, examples of 2D and 3D flow calculations. C.D.

A92-29998

STUDY OF A CLASS OF TWO-POINT BOX SCHEMES WITH APPLICATION TO ONE-DIMENSIONAL FLUID DYNAMICS

B. COURBET (ONERA, Chatillon, France) La Recherche Aeronautique (English Edition) (ISSN 0379-380X), no. 5, 1991, p. 31-44. refs
Copyright

An analysis of compact two-point techniques utilized in numerical simulations of nonsteady compressible flows is presented. The approach described can be used to construct more accurate schemes easily, and ones which are also quite appropriate for representing nonsteady flow phenomena (shocks, contact discontinuities, expansions). The resulting unsteady numerical solutions are shown to be of good quality. R.E.P.

A92-31164

CALCULATIONS OF THE DILUTION SYSTEM IN AN ANNULAR GAS TURBINE COMBUSTOR

J. J. MCGUIRK and J. M. L. M. PALMA (Imperial College of Science, Technology, and Medicine, London, England) AIAA Journal (ISSN 0001-1452), vol. 30, April 1992, p. 963-972. Research supported by Ministry of Defence of England. refs
Copyright

The present work is concerned with the ability of a two-equation turbulence model (K-epsilon) of predicting accurately the mixing parameters at the outlet of an annular gas turbine combustor. A comparison between numerical and experimental results is presented with attention paid to numerical accuracy and boundary condition sensitivity. A numerical grid with 36,000 nodes was needed to resolve the flow inside a 7.5-deg annular sector. It was found that an insufficient number of grid nodes led to the underprediction of the streamwise vorticity and a different flow pattern in the wake and downstream of the jets. Two basic sets of calculations with constant and variable density are included. The calculations could predict the general features of the flow, but evidenced lower levels of mixing compared to the experiments, even with a reduction of the turbulent Prandtl number from 0.9 to 0.5. Author

A92-31196

DIRECT AND LARGE-EDDY SIMULATIONS OF TRANSITION IN THE COMPRESSIBLE BOUNDARY LAYER

XAVIER NORMAND and MARCEL LESIEUR (Grenoble, Institut de Mecanique, France) Theoretical and Computational Fluid Dynamics (ISSN 0935-4964), vol. 3, Feb. 1992, p. 231-252. Research supported by CNES and CNRS. refs
(Contract DRET-87-808-11; DRET-88-150)
Copyright

The transition to turbulence in the 3D compressible boundary layer over a semiinfinite flat plate is evaluated by direct and large-eddy simulations. Direct numerical simulations were conducted at low Mach, while the utilization of a subgrid-scale parameterization was necessary for the high Mach number case, as it was necessary to increase the Reynold's number. A new subgrid-scale model, based on the second-order velocity structure function and tested satisfactorily in isotropic turbulence, was utilized for the first time in a compressible shear flow. R.E.P.

A92-31399

WELL-POSEDNESS IN THE GENERALIZED SENSE FOR BOUNDARY LAYER SUPPRESSING BOUNDARY CONDITIONS

B. C. V. JOHANSSON (Royal Institute of Technology, Stockholm, Sweden) Journal of Scientific Computing (ISSN 0885-7474), vol. 6, Dec. 1991, p. 391-414. Research supported by Swedish Institute of Applied Mathematics. refs
(Contract STU-88-01599P; N00014-83-K-0422)
Copyright

The time-dependent Navier-Stokes equation for incompressible fluid flow together with boundary-layer-suppressing boundary conditions for open boundaries is investigated. In these boundary conditions one typically prescribes a high-order derivative of some of the dependent variables. These boundary conditions give rise to a problem that is well posed in the generalized sense. This means that there exists a unique smooth solution of the linearized problem and that this solution can be estimated by data. Author

A92-31451

MIXING BY CHAOTIC ADVECTION IN A CLASS OF SPATIALLY PERIODIC FLOWS

SUSAN C. RYRIE (Bristol, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 236, March 1992, p. 1-26. Research supported by SERC. refs
Copyright

The paths followed by individual fluid particles can be extremely complicated even in smooth laminar flows. Such chaotic advection causes mixing of the fluid. This phenomenon is studied analytically for a class of spatially periodic flows comprising a basic flow of two-dimensional (or axisymmetric) counter-rotating vortices in a layer of fluid, and modulated by a perturbation which is periodic in time and/or space. Examples of this type of flow include Benard convection just above the point of instability of two-dimensional roll cells, and Taylor vortex flow between concentric rotating cylinders. The transport of chaotically advected particles is modeled as a Markov process. This predicts diffusion-like mixing, and provides an expression for the diffusion coefficient. This expression explains some features of experimental results reported by Solomon and Gollub (1988): its accuracy is investigated through a detailed comparison with numerical results from a model of wavy Taylor vortex flow. The approximations used in the analysis are equivalent to those used to obtain the quasi-linear result for diffusion in the standard map. Author

A92-31460

KINEMATIC SIMULATION OF HOMOGENEOUS TURBULENCE BY UNSTEADY RANDOM FOURIER MODES

J. C. H. FUNG, J. C. R. HUNT, N. A. MALIK, and R. J. PERKINS (Cambridge, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 236, March 1992, p. 281-318. Research supported by SERC, Central Electricity Generating Board, Department of Trade and Industry, and Wolfson Foundation. refs
Copyright

In the present simulation, the statistics of an unsteady random velocity field are adjusted to agree with experimentally measured values of two-point space-time Eulerian and Lagrangian statistics for homogeneous turbulence. This simulation, which may be applicable where no small-scale model is currently available, is not grid-based and obviates the solution of any set of equations; it is ideally implemented by means of parallel computer. The method can be extended to allow for shear and for the effects of rigid walls. O.C.

A92-31461

TWO-DIMENSIONAL PATTERNS IN RAYLEIGH-TAYLOR INSTABILITY OF A THIN LAYER

M. FERMIGIER, L. LIMAT, J. E. WESFRED, P. BOUDINET, and C. QUILLIET (Paris, Ecole Supérieure de Physique et de Chimie, France) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 236, March 1992, p. 349-383. Research supported by INSU, NSF, and CNRS. refs
Copyright

The paper studies experimentally and theoretically the evolution of 2D patterns in the Rayleigh-Taylor instability of a thin layer of viscous fluid spread on a solid surface. Various kinds of patterns of different symmetries are observed, with possible transition between patterns, the preferred symmetries being the axial and hexagonal ones. Starting from the lubrication hypothesis, the nonlinear evolution equation of the interface and the amplitude equation of its Fourier components are derived. The evolution laws of the different patterns are calculated at order 2 or 3 the preferred symmetries being related to the noninvariance of the system by amplitude reflection. The dripping at final stage of the instability is discussed qualitatively. Author

A92-31488

GENERATION, OPTIMIZATION AND ADAPTATION OF MULTIBLOCK GRIDS AROUND COMPLEX CONFIGURATIONS IN COMPUTATIONAL FLUID DYNAMICS

OLIVIER-PIERRE JACQUOTTE (ONERA, Direction de l'Aerodynamique, Chatillon, France) (International Association for Computational Mechanics, World Congress of Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 34, March 30, 1992, p. 443-454. refs

(ONERA, TP NO. 1992-30) Copyright

A method is presented that has been developed for the construction of grids suitable for a large class of computational fluid dynamics solvers. Three independent steps are considered: a multidomain generation, an optimization, and an adaptation. The first step handles the complexity of the 3D domain to be meshed and is able to perform an algebraic construction of the grid points within a multidomain topology; any decomposition can be considered and analyzed by the algorithm. The second step is able to optimize a mesh with respect to a quality measure defined in terms of cell deformation; a conjugate gradient algorithm drives the nodes up to an equilibrium position that realizes the minimum of a mesh energy quantity. The final step handles the physics of the problem and moves the nodes in order to refine the mesh where anything of interest takes place, while preserving its good metric quality. The three steps have been implemented independently and successfully, as shown by the examples presented. Author

A92-31665# National Aeronautics and Space Administration, Washington, DC.

A 3D FINITE ELEMENT MULTIGRID SOLVER FOR THE EULER EQUATIONS

J. PERAIRE, J. PEIRO (Imperial College of Science, Technology, and Medicine, London, England), and K. MORGAN (Swansea, University College, Wales) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 10 p. Research supported by Dassault Aviation. refs

(Contract NAGW-1809; NCCW-00010)

(AIAA PAPER 92-0449) Copyright

A low storage, computationally efficient algorithm for the solution of the compressible Euler equations on unstructured tetrahedral meshes is developed. The algorithm takes the form of a centered scheme with the explicit addition of a high accuracy artificial viscosity and the solution is advanced to steady state by means of a multistage timestepping method. The side-based data structure which is employed enables a clear connection to be established between the proposed algorithm and upwind cell vertex schemes for unstructured meshes. The computational efficiency of the procedure is improved by incorporating an unstructured multigrid acceleration procedure. A number of flows of practical interest are analyzed to demonstrate the numerical performance of the proposed approach. Author

A92-32228

NONLINEAR INTERACTION OF OBLIQUE THREE-DIMENSIONAL TOLLMIE-SCHLICHTING WAVES AND LONGITUDINAL VORTICES, IN CHANNEL FLOWS AND BOUNDARY LAYERS

F. T. SMITH (University College, London, England) and P. BLENNERHASSETT (New South Wales, University, Kensington, Australia) Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences (ISSN 0962-8444), vol. 436, March 9, 1992, p. 585-602. Research supported by ICASE and SERC. refs

(Contract AF-AFOSR-89-0475)

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The present theoretical article considers the nonlinear interaction of oblique 3D Tollmien-Schlichting waves and induced or input longitudinal vortex motion, mainly for channel flow at large Reynolds numbers. Both the waves and the vortices are controlled by viscous-inviscid balancing but their respective flow structures are rather different because of the different typical timescales involved. This leads to the vortex-wave interaction being governed by nonlinear evolution equations on the vortex timescale, even though the wave amplitudes are notably small. Computational and analytical properties of the interaction equations for both channel flows and boundary layers are investigated, along with certain connections with companion studies of other vortex-wave interactions in channel flow. The nonlinear interactions in channel flow are found to lead to finite-time blow-up in amplitudes or to sustained vortex flow at large scaled times, depending on the input conditions. Author

A92-32240

HEAT TRANSFER EFFECTS ON AERODYNAMICS AND IMPLICATIONS FOR WIND-TUNNEL TESTS

D. G. MABEY (Royal Aerospace Establishment, Bedford, England) Journal of Aircraft (ISSN 0021-8669), vol. 29, Mar.-Apr. 1992, p. 224-230. Previously cited in issue 23, p. 4069, Accession no. A91-53758. refs

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A92-33466

SIMULATION OF 2D EXTERNAL VISCOUS FLOWS BY MEANS OF A DOMAIN DECOMPOSITION [SIMULATION DES ECOULEMENTS VISQUEUX BIDIMENSIONNELS PAR UNE METHODE DE DECOMPOSITION DE DOMAINES]

JEAN-LUC GUERMOND, SERGE HUBERSON, and WHEN-ZHONG SHEN (CNRS, Laboratoire d'Informatique pour la Mecanique et les Sciences pour l'Ingenieur, Orsay, France) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de la Terre et de l'Univers (ISSN 0764-4450), vol. 314, no. 6, March 12, 1992, p. 557-562. In French. refs

Copyright

Two-dimensional external viscous flows are numerically approximated by means of a domain decomposition technique which combines a vortex method and a finite-difference method. The vortex method is used in the flow region which is dominated by convective effects, whereas the finite difference method is used in the flow region where viscous diffusion effects are dominant. Author

A92-36192

A SIMPLE POINT VORTEX MODEL FOR TWO-DIMENSIONAL DECAYING TURBULENCE

R. BENZI, M. COLELLA (Roma II, Universita, Rome, Italy), M. BRISCOLINI, and P. SANTANGELO (IBM European Center for Scientific and Engineering Computing, Rome, Italy) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 5, May 1992, p. 1036-1039. Research supported by IBM Corp. refs

(Contract EEC-SCI-0212-C)

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The statistical properties of two-dimensional decaying turbulence, for nonsmooth initial conditions, are studied by using a particular model of point vortex dynamics that allows vortex merging. A quantitative agreement with respect to spectral simulations is shown. Author

A92-36347

NUMERICAL STUDY OF AN OSCILLATING CYLINDER IN UNIFORM FLOW AND IN THE WAKE OF AN UPSTREAM CYLINDER

JING LI (Institut de Mecanique des Fluides, Marseille, France), JIONG SUN (Aix-Marseille I, Universite, Marseille, France), and BERNARD ROUX (Institut de Mecanique des Fluides, Marseille, France) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 237, April 1992, p. 457-478. refs
Copyright

The response of a circular oscillating cylinder in uniform flow and in the wake of an upstream cylinder is investigated by means of a direct numerical simulation. It is found that the response state of the cylinder wake is either a periodic (lock-in) state, where the vortex shedding frequency equals the forcing frequency, or a quasi-periodic (nonlock-in) state, where the shedding frequency shows a smooth variation with the driving frequency. Both states are functions of forcing frequency and excitation amplitude. The chaotic state found by Karniadakis and Triantafyllou (1989) was not observed. For a cylinder oscillating in the wake of an upstream cylinder, the response state is strongly influenced by the distance between the two cylinders. The numerical results are found to agree with available experimental data. I.S.

A92-37388

A STRUCTURED TRI-TREE SEARCH METHOD FOR GENERATION OF OPTIMAL UNSTRUCTURED FINITE ELEMENT GRIDS IN TWO AND THREE DIMENSIONS

S. O. WILLE (Oslo, University, Norway) *International Journal for Numerical Methods in Fluids* (ISSN 0271-2091), vol. 14, no. 7, April 15, 1992, p. 861-881. Research supported by Norwegian Fisheries Research Council. refs
Copyright

A new method for generating finite element grids in two and three dimensions is developed. The method is based on a new search tree structure. The search tree is built upon triangles in two dimensions and tetrahedra in three dimensions. The density of elements can be varied throughout the computational domain. Efficient search algorithms for finding points in space and for finding the boundary of the domain have been developed. The speed of the grid algorithm will permit adaptive gridding during computation. The grid algorithm is generally applicable to both hydrodynamic as well as aerodynamic finite element computations. The technique has been used with success for gridding the North Sea-Skagerrak area. Author

A92-37504

A VELOCITY-PRESSURE STREAMLINE DIFFUSION FINITE ELEMENT METHOD FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS

PETER HANSBO (Chalmers University of Technology, Goteborg, Sweden) and ANDERS SZEPESSY (New York University, NY) *Computer Methods in Applied Mechanics and Engineering* (ISSN 0045-7825), vol. 84, no. 2, Dec. 1990, p. 175-192. Research supported by STU and Swedish Institute of Applied Mathematics. refs
Copyright

A streamline diffusion finite-element method is introduced for the time-dependent incompressible Navier-Stokes equations in a bounded domain in R^2 and R^3 in the case of a flow with a high Reynolds number. An error estimate is proved and numerical results are given. The method is based on a mixed velocity-pressure formulation using the same finite-element discretization of space-time for the velocity and the pressure spaces, which consist of piecewise linear functions, together with certain least-squares modifications of the Galerkin variational formulation giving added stability without sacrificing accuracy. Author

A92-37535

ADAPTIVE STREAMLINE DIFFUSION METHODS FOR COMPRESSIBLE FLOW USING CONSERVATION VARIABLES

PETER HANSBO and CLAES JOHNSON (Chalmers University of

Technology, Goteborg, Sweden) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) *Computer Methods in Applied Mechanics and Engineering* (ISSN 0045-7825), vol. 87, no. 2-3, June 1991, p. 267-280. refs
Copyright

A streamline diffusion (SD) finite element method based on conservation variables is applied to compressible flow. Adaptive algorithms based on a posteriori error estimates for the SD method in the case of convection-dominated problems are described. Computational results for adaptive SD methods applied to the nonstationary Euler equations for a 2D compressible flow are presented. O.G.

A92-37573

ADAPTIVE METHODS IN COMPUTATIONAL FLUID DYNAMICS OF CHEMICALLY REACTING FLOWS

B. ROGG (Cambridge, University, England) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) *Computer Methods in Applied Mechanics and Engineering* (ISSN 0045-7825), vol. 90, no. 1-3, Sept. 1991, p. 659-670. refs
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Possible approaches to fully implicit adaptive algorithms suitable for the numerical simulation of unsteady two-dimensional reactive flows are examined. Emphasis is placed on self-adaptive gridding procedures applicable to time-dependent two-dimensional reactive flows. Pulsating flame propagation, autoignition in a nonpremixed flow, flame propagation in a strained mixing layer, and hot-spot-like self-ignition are considered as examples. V.L.

A92-37932

MARANGONI CONVECTION IN V-SHAPED CONTAINERS

H. W. HOOGSTRATEN, H. C. J. HOEFSLOOT, and L. P. B. M. JANSSEN (Groningen, State University, Netherlands) *Journal of Engineering Mathematics* (ISSN 0022-0833), vol. 26, no. 1, Feb. 1992, p. 21-37. refs
Copyright

This paper presents a numerical study of the time evolution of Marangoni convection in two V-shaped containers involved in the microgravity experiments reported in Hoefsloot et al. (1991). First the case of the triangular container with a plane gas/liquid interface is considered, next the container having the shape of a circular sector with a curved interface is dealt with. The numerical results show the same behavior as observed experimentally: convection caused by macroscale effects in the former, and microconvection in the latter case. Author

A92-37936

PLAYING WITH NONUNIFORM GRIDS

A. E. P. VELDMAN and K. RINZEMA (Groningen, State University, Netherlands) *Journal of Engineering Mathematics* (ISSN 0022-0833), vol. 26, no. 1, Feb. 1992, p. 119-130. refs
Copyright

Numerical experiments with discretization methods on nonuniform grids are presented for the convection-diffusion equation. These show that the accuracy of the discrete solution is not very well predicted by the local truncation error. The diagonal entries in the discrete coefficient matrix give a better clue: the convective term should not reduce the diagonal. Also, iterative solution of the discrete set of equations is discussed. The same criterion appears to be favorable. Author

A92-38868

INVESTIGATION OF FLAME-GENERATED TURBULENCE IN PREMIXED FLAMES AT LOW AND HIGH BURNING VELOCITIES

YANSON LIU (ABB Turbo Systems, Ltd., Fluid Flow and Combustion Laboratory, Baden, Switzerland) and BERNHARD LENZE (Karlsruhe, Universitaet, Federal Republic of Germany) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) *Experimental Thermal and Fluid Science*

(ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 410-415. Research supported by BMFT. refs
Copyright

Knowledge of the dependence of turbulent flame velocity on such parameters as fuel properties, turbulent fluctuations, and length scales is of central importance for industrial applications such as combustion in motors, gas turbine combustors, and domestic burners. Two unanswered questions concern how aerodynamic turbulence influences the reaction and/or flame speed and how the reaction intensity influences the aerodynamic turbulence values. The reaction velocity has been measured in a stagnation point flame, the turbulence intensities and length scales before and after the flame front being recorded by an LDV system. Laminar burning velocity was varied by using different concentrations of methane-hydrogen-air mixtures. The results show under certain conditions an immense increase in turbulent fluctuations in and after the flame front, measured using conditioned and unconditioned LDV techniques. Author

A92-38897

RELAXATION OF EULER EQUATIONS AND HYDRODYNAMIC INSTABILITIES

JEAN DUCHON and RAOUL ROBERT Quarterly of Applied Mathematics (ISSN 0033-569X), vol. 50, no. 2, June 1992, p. 235-255. refs
Copyright

A relaxed version of incompressible Euler equations is presented that permits foliated flows involving two velocities. These relaxed equations allow a two-phase evolution of some vortex sheets as an alternative to discontinuous solutions of Euler equations. In the case of two perfect fluids of different densities superposed one over the other, this relaxation process yields a linearly well-posed two-phase solution. Author

A92-40054

LARGE-EDDY SIMULATION OF THE CONVECTIVE BOUNDARY LAYER - A COMPARISON OF FOUR COMPUTER CODES

F. T. M. NIEUWSTADT (Delft University of Technology, Netherlands), P. J. MASON (Meteorological Office, Bracknell, England), C. H. MOENG (NCAR, Boulder, CO), and U. SCHUMANN (DLR, Institut fuer Physik der Atmosphaere, Oberpfaffenhofen, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 1-4-1 to 1-4-6. refs

To test the consistency of large-eddy simulation, four existing large-eddy codes were run for the same case of the convective atmospheric boundary layer. The four models differ in various details, such as: the subgrid model, numerics, and boundary conditions. The agreement between the four models is excellent. In general, model results lie within the scatter of available observation. Most of the disagreement between the model results can be attributed to the parameter C(s) of the subgrid model. The effect of other differences between the four models is found to be small. Author

A92-40083

COMPUTATION OF IMPINGING FLOWS USING SECOND-MOMENT CLOSURES

T. J. CRAFT and B. E. LAUNDER (University of Manchester Institute of Science and Technology, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 8-5-1 to 8-5-6. Research supported by AEA Technology. refs

The paper considers the problem of modeling turbulent transport in stagnating jet flows via second-moment closure. In the case of colliding jets it is shown that a new model introduced at TSF 7 is more successful than the usually adopted scheme in predicting the high spreading rate of the radial fountain. For normal jet impingement against a plane wall it is found that the usually adopted model of pressure-reflection effects gives a correction of the wrong

sign in stagnating flows. A new version is proposed that gives satisfactory agreement with experiment in impinging strain fields while maintaining the desired form for flow parallel to the surface. Author

A92-40088

THREE-DIMENSIONAL SEPARATED FLOWS

F. MCCLUSKEY, P. E. HANCOCK, and I. P. CASTRO (Surrey, University, Guildford, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-5-1 to 9-5-6. Research supported by SERC. refs

In a preliminary study, three regions of three-dimensional separated turbulent flow have been considered, in the first instance, by means of surface flow patterns. The three regions have particular significance in terms of extra rates of strain. Some mean velocity and Reynolds stress measurements have been made using pulsed-wire anemometry in one of these - a nominally spanwise-invariant region. Even for large aspect ratios (compared with those used for previous detailed studies) the type of flow near the 'upstream sidewall' may affect the flow near reattachment, and the wind-tunnel side walls cause an apparently significant spanwise variation in pressure. Author

A92-40089

LARGE EDDY SIMULATION APPLIED TO THE MODELLING OF PARTICULATE TRANSPORT COEFFICIENTS IN TURBULENT TWO-PHASE FLOWS

E. DEUTSCH and O. SIMONIN (Electricite de France, Laboratoire National d'Hydraulique, Chatou) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 10-1-1 to 10-1-6. refs

Statistical characteristics of particles suspended in an homogeneous and steady fluid turbulence have been studied using large eddy simulation. Computations have been carried out for three typical particle/fluid density ratio with the particle equation of motion including drag, fluid pressure, and added-mass forces. Numerical predictions are compared with analytical expressions obtained by an extended approach of the Tchen's theory which takes into account crossing-trajectories effects. In parallel, the computation of the particulate transport coefficients validates closure assumptions used in the frame of the Eulerian two-fluid modeling with a special care about the separate contribution to dispersion induced by the transport of particles by the turbulent fluid motion. Author

A92-40097

A THEORETICAL AND NUMERICAL INVESTIGATION OF WAVE-TURBULENCE INTERACTIONS

J. MAGNAUDET and J. QUEYRON (Toulouse, Institut de Mecanique des Fluides, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 11-5-1 to 11-5-5. refs

The dynamical interactions occurring between periodic surface waves, turbulence and mean current are analyzed by considering the orbital vorticity balance closed using an eddy-viscosity model. It is theoretically shown how these interactions induce an energy transfer from the waves to the mean motion and then modify the mean momentum and turbulence energy balances. Numerical computations using a simple one-point closure with boundary conditions appropriate for interfacial turbulence are presented. The results show that the turbulence energy is highly increased by these interactions and reaches the unusual level that has been measured below wind waves. Author

A92-40102

SECOND MOMENT CLOSURE PREDICTIONS OF JET-ON-JET IMPINGEMENT FLOWS

S. J. BAKER (Imperial College of Science, Technology, and Medicine, London, England) and J. J. MCGUIRK (Loughborough

University of Technology, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 13-1-1 to 13-1-6. Research supported by Ministry of Defence Procurement Executive of England. refs

Consideration is given to calculations which contrast the performance of eddy viscosity and second moment closure turbulence models for confined flows dominated by jet-on-jet impingement. Flow configurations relevant to gas-turbine and ramjet side-dump combustors are chosen, with emphasis placed on 2D systems, one plane and one axisymmetric, to allow sufficiently fine meshes to avoid numerical errors. The particular second closure adopted is the Gibson-Launder Reynold stress transport model, using two alternative sets of constants in the pressure-strain model. For the axisymmetric case, the second moment closure performs significantly better than the eddy viscosity model; improved predictions are obtained for both the strength of recirculation upstream of impingement and the rate of recovery of the downstream velocity profiles. Large-scale period oscillations which are not well modeled by any long-time-average closure are also found. C.A.B.

A92-40107

FLOW STRUCTURE AND MIXING IN OBSTRUCTED AND CONFINED JETS

S. G. BRYCE and R. E. J. FRYER-TAYLOR (Shell Research, Ltd., Chester, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 14-2-1 to 14-2-6. refs

A comprehensive series of smoke flow visualization and laser induced fluorescence experiments was performed in a study of the dispersion processes of obstructed and confined incompressible gas jets. It was found that large-scale vortical structures dominated the entrainment of ambient air into a free jet. The presence of obstacles within the flowfield generated additional vorticity which locally enhanced the concentration decay within the release. However, the creation of recirculatory regions in the wake of certain obstacles reduced entrainment into these areas. For hazardous releases, this could give rise to a steady flammable or toxic mixture within the wake. Author

A92-40123

MEASUREMENTS AND MODELLING OF THE TURBULENT NEAR WAKE FLOW OF A DISK WITH A CENTRAL JET

D. F. G. DURAO, G. KNITTEL, J. C. F. PEREIRA, and J. M. P. ROCHA (Lisboa, Universidade Tecnica, Lisbon, Portugal) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 17-5-1 to 17-5-6. refs

(Contract CEC-PL890926)

LDV measurements of the velocity and turbulence characteristics and their comparison with numerical solutions are reported for the near wake recirculating flow around a disk with a central jet. Both the two-equation k-epsilon eddy-viscosity model and the second-moment Reynolds stress transport closure (RSM) were used to close the mean-field equations. The 13-point quadratic weighted upstream scheme was used for convection discretization and employed in all transport equations. It was found that the present flow configuration requires a very high computational resolution for numerical accuracy. Like other disk flow predictions, significant differences were noticed between the two levels of turbulence closure. The RSM provides a significantly better description of mean field compared with k-epsilon eddy viscosity model. None of the models is able to predict accurately the turbulence field. Author

A92-40129

AN ALGEBRAIC PROPERTY OF THE TURBULENT STRESS AND ITS POSSIBLE USE IN SUBGRID MODELING

M. GERMANO (Torino, Politecnico, Turin, Italy) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of

Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 19-1-1 to 19-1-6. Research supported by MURST. refs

A new approach to the study of turbulence, based on the general algebraic properties of the filtered representations of a turbulent field at different filtering levels, is presented. New quantities, the generalized central moments and the generalized turbulent stresses are introduced, and an algebraic identity that relates these quantities at different levels is deduced. This new approach extends the statistical approach to a general implicit or explicit filtering operator and it represents in the opinion of the author a simple way to study the similarity of the turbulence at different levels. A particular application of this approach to the subgrid scale (SGS) modeling in the large eddy simulation (LES) of turbulent flows, based on the definition and the utilization of the resolved turbulence, is discussed. Author

A92-40131

COMPUTATIONS OF A SEPARATED TURBULENT BOUNDARY LAYER

K. N. ATKINSON and I. P. CASTRO (Surrey, University, Guildford, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 20-2-1 to 20-2-6. Research supported by Ministry of Defence Procurement Executive of England. refs

Numerical solutions of a separated turbulent boundary layer, obtained using standard k-epsilon and differential stress models, are presented. To achieve satisfactory separation the dissipation equation in both models had to be modified in the upstream part of the boundary layer; without this modification both models failed to predict separation. Despite the final solutions showing reasonable agreement with experiment in terms of skin friction and boundary layer growth rates, they are far from adequate in terms of the behavior of Reynolds stresses and turbulence kinetic energy. This is particularly true around separation for both turbulence models but also, in the case of the differential stress model, in the whole of the separated region. It is argued that the usual assumptions embodied by such models do not really reflect the nature of the turbulence in strongly adverse pressure gradient and/or separated flow regions. Author

A92-40156

A MODEL FOR BURSTING OF NEAR WALL VORTICAL STRUCTURES IN BOUNDARY LAYERS

PAOLO ORLANDI (Roma I, Universita, Rome, Italy) and JAVIER JIMENEZ (Madrid, Universidad Politecnica, Spain) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 28-1-1 to 28-1-6. Research supported by MPI and United Technologies Corp. refs

In the last decade, much effort has been devoted to the understanding of near wall turbulence, both through experimental and numerical observations. Different scenarios have been proposed, but a broad consensus on a basic model for the near wall events has still not been achieved. A simple numerical model for some of the events occurring during the bursting phenomenon is presented. In particular the behavior of longitudinal vortices as they are brought near a wall by an x-dependent external shear, which is the near wall equivalent of a plane strain is studied. The effect of the interaction on the local wall stress is studied, and the distributions of turbulent stresses to analyze the zones of maximum production in the transversal y-z plane are calculated. Author

A92-40158

PROGRESS AND PARADOXES IN MODELLING NEAR-WALL TURBULENCE

B. E. LAUNDER and D. P. TSELEPIDAKIS (University of Manchester Institute of Science and Technology, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2.

University Park, PA, Pennsylvania State University, 1991, p. 29-1-1 to 29-1-6. refs
(Contract SERC-GR/D/8285/2)

The paper considers the modeling, within the framework of second-moment closure, of the turbulent stress field in the wall-adjacent sublayer. Particular attention is given to handling wall-proximity effects on the pressure-strain and stress-dissipation processes. Comparisons of the resultant model with the direct numerical simulations of plane channel flow show close agreement of the Reynolds stress profiles at two Reynolds numbers.

Author

A92-40161

STRUCTURE AND MODELLING IN STRONGLY SHEARED TURBULENT COMPRESSIBLE FLOW

Y. LEBRET, D. VANDROMME (Rouen, Institut National des Sciences Appliquées, Mont-Saint-Aignan, France), and H. HAMINH (Toulouse, Institut de Mécanique des Fluides, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 29-4-1 to 29-4-5. Research supported by DRET and SNECMA. refs

The coherent structures in compressible turbulent shear flows are characterized, and the filtering features due to the numerical integration are analyzed. The evolution of the mixing layer growth with respect to a characteristic Mach number is traced. It is found that unsteady features can be resolved with a standard $k - \epsilon$ model.

C.A.B.

A92-40170

NUMERICAL SIMULATION AND MODELLING OF THE TRANSITION PAST A RECTANGULAR AFTERBODY

M. BRAZA and P. NOGUES (Institut de Mécanique des Fluides, Toulouse, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-2-1, 1-2-2. refs

The paper shows the ability of the phase-averaged Navier-Stokes equations with an improved eddy viscosity model to preserve the organized unsteady period motion, developed simultaneously with the onset of turbulence, in the wake past a rectangular afterbody. It is shown that the instability leading to the formation of organized vortices in the wake is clearly obtained with or without application of the present adapted unsteady turbulence model.

P.D.

A92-40172

SIMULATION OF TURBULENT VELOCITY PROFILES APPEARING ON ROTATING AND STATIONARY PARTS OF SUBSONIC COMPRESSORS AND TURBINES

J. K. KALDELLIS (Piraeus, University, Athens, Greece) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-6-1, 1-6-2. refs

The successful analysis of the viscous flowfield through any type of turbomachine is based on the use of a closed analytical formulation in the primary direction. An extended and improved form of the classical turbulent shear layer theory is developed to take into account the complex flow pattern through rotating and stationary parts of real turbomachines. The resulting model is successfully applied for a large variety of subsonic compressors and turbines.

Author

A92-41655

ON A CLASS OF UNSTEADY THREE-DIMENSIONAL NAVIER-STOKES SOLUTIONS RELEVANT TO ROTATING DISC FLOWS - THRESHOLD AMPLITUDES AND FINITE-TIME SINGULARITIES

PHILIP HALL (Manchester, Victoria University, England), P. BALAKUMAR (High Technology Corp., Hampton, VA), and D. PAPAGEORGIOU (New Jersey Institute of Technology, Newark)

Journal of Fluid Mechanics (ISSN 0022-1120), vol. 238, May 1992, p. 297-323. Research supported by SERC and USAF. refs
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In the course of an investigation of the strongly nonlinear instability of the boundary layer on a rotating disk, a class of exact steady and unsteady Navier-Stokes solutions was formulated which describe the flow over a rotating disk immersed in a 3D stagnation-point flowfield. The paper discusses some steady equilibrium states of these equations, the unsteady form of the interaction equations, and the linear and nonlinear instability of the flow over a rotating disk in an otherwise still fluid. It is shown that sufficiently large perturbations lead to a finite-time breakdown of the flow, while smaller disturbances decay to zero. If the stagnation point flow at infinity is sufficiently strong, the steady basic states become linearly unstable.

I.S.

A92-41656*

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

TURBULENCE - THE FILTERING APPROACH

M. GERMANO (Torino, Politecnico, Turin, Italy) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 238, May 1992, p. 325-336. Research supported by Stanford University, NASA, and MURST. refs

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The paper describes a new operatorial approach to the study of turbulence, based on the general algebraic properties of the filtered representations of a turbulence field at different levels. The main results of this analysis is the averaging invariance of the filtered Navier-Stokes equations in terms of the generalized central moments, and an algebraic identity that relates the turbulent stresses at different levels. The resolved turbulence is defined, the algebraic consistency rules that relate these resolved quantities to the turbulent stresses at different levels are derived, and their possible uses in subgrid modeling is discussed.

I.S.

A92-41814*

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE NUMERICAL DYNAMIC FOR HIGHLY NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS [LA DYNAMIQUE DU NUMERIQUE POUR DES EQUATIONS AUX DERIVEES PARTIELLES FORTEMENT NON LINEAIRES]

A. LAFON (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) and H. C. YEE (NASA, Ames Research Center, Moffett Field, CA) Revue Scientifique et Technique de la Défense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 19-35. In French. refs

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Problems associated with the numerical computation of highly nonlinear equations in computational fluid dynamics are set forth and analyzed in terms of the potential ranges of spurious behaviors. A reaction-convection equation with a nonlinear source term is employed to evaluate the effects related to spatial and temporal discretizations. The discretization of the source term is described according to several methods, and the various techniques are shown to have a significant effect on the stability of the spurious solutions. Traditional linearized stability analyses cannot provide the level of confidence required for accurate fluid dynamics computations, and the incorporation of nonlinear analysis is proposed. Nonlinear analysis based on nonlinear dynamical systems complements the conventional linear approach and is valuable in the analysis of hypersonic aerodynamics and combustion phenomena.

C.C.S.

A92-41875

AN OVERVIEW OF BOUNDARY INTEGRAL FORMULATIONS FOR POTENTIAL FLOWS IN FLUID-FLUID SYSTEMS

E. CANOT and J.-L. ACHARD (Grenoble, Institut de Mécanique, France) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 4, 1991, p. 453-498. Research supported by DRET. refs
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Three-dimensional flow problems involving a system of two incompressible constant-density fluids separated by a moving interface are investigated, comparing the theoretical foundations

and numerical implementation of two classes of boundary-integral methods based on the irrotational-flow approximation (Baker et al., 1982; Roberts, 1983). Although the strength of the singularity induced at the interface obeys a general Fredholm integral equation of the second kind in each case, the method of Roberts is found to be simpler to apply in practice. Numerical results for vibration in a spherical globule and for the axisymmetric Rayleigh-Taylor instability in an unbounded fluid-fluid system are presented in graphs and discussed in detail: good general agreement with experimental data is observed. T.K.

A92-42300**A NUMERICAL SIMULATION OF BOUNDARY LAYER EFFECTS IN A SHOCK TUBE**

K. J. BADCOCK (Oxford, University, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 14, no. 10, May 30, 1992, p. 1151-1171. Research supported by SERC. refs

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A numerical scheme is used to investigate boundary layer effects in a shock tube. The method consists of a mixture of Roe's approximate Riemann solver and central differences for the convective fluxes and central differences for the viscous fluxes and is implicit in one space dimension. Comparisons are made with experimental data and with solutions obtained via boundary layer equations. Examination of the calculated flowfield explains the observed behavior and highlights the approximate nature of boundary layer solutions. Author

A92-42529**BIENNIAL FLUID DYNAMICS SYMPOSIUM ON ADVANCED PROBLEMS AND METHODS IN FLUID MECHANICS, 19TH, KOZUBNIK, POLAND, SEPT. 3-8, 1989, SELECTED PAPERS**

Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, 130 p. For individual items see A92-42530 to A92-42536.

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Recent advances in experimental and computational fluid mechanics are discussed in a series of review essays. Topics addressed include transitions to complex flow in thermal convection, optimum hypersonic wings and wave riders, relativistic hydrodynamics, and wind-tunnel wall corrections for unsteady flow (steady wall adaptation and CFD techniques). Consideration is given to axisymmetric laminar interacting boundary layers, differential forms and fluid dynamics, breaking water waves, strong temperature gradients in turbulent wakes, and liquid-crystal 'blue' phases. T.K.

A92-42534**AXISYMMETRIC LAMINAR INTERACTING BOUNDARY LAYERS**

A. KLUWICK (Wien, Technische Universitaet, Vienna, Austria) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989. A92-42529 17-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, p. 623-651. Research supported by NSF. refs

(Contract FFWF PROJECT P-5557)

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The computation of high Reynolds number laminar viscous inviscid interaction phenomena has been one of the central issues in fluid mechanics over the past two decades. An important contribution to the understanding of such flows has been provided by asymptotic theories. In particular these theories show that a locally interacting laminar boundary layer develops a multilayer structure. Viscous effects are of importance only inside a thin region adjacent to the wall where the flow is governed by the boundary layer equations, the pressure being coupled to the displacement thickness. Owing to the complicated general form of the pressure-displacement relationship most studies of local interaction processes deal with the case of two-dimensional flow. Three-dimensional interaction effects can be investigated more

easily, however, if it is possible to exploit symmetry properties as in the case of axisymmetric flow. Author

A92-42535**DIFFERENTIAL FORMS AND FLUID DYNAMICS**

Z. PERADZYSKI (Polish Academy of Sciences, Institute of Fundamental Technological Research, Warsaw, Poland) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989. A92-42529 17-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, p. 653-661. refs

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A formulation of some fundamental equations of fluid dynamics based on exterior differential forms (Flanders, 1963) is developed analytically. The derivation is outlined, with particular attention to the exterior derivative, the Stokes theorem, the pull-back of differential forms, restriction of a form to a submanifold, the commutation property, the case of an ideal barotropic fluid, the relationship between exterior and Lie derivatives, and the conservation of helicity. The advantages of this formulation over vector fields for curvilinear coordinate systems are pointed out, and its applicability to the dynamics of superfluids or to magnetohydrodynamics is indicated. T.K.

A92-43045**VORTICITY SHEDDING AND ACOUSTIC RESONANCE IN AN IN-LINE TUBE BUNDLE. I - VORTICITY SHEDDING. II - ACOUSTIC RESONANCE**

S. ZIADA and A. OENGOEREN (Sulzer Innotec, Winterthur, Switzerland) Journal of Fluids and Structures (ISSN 0889-9746), vol. 6, no. 3, May 1992, p. 271-309. Research supported by Schweizerisches Bundesamt fuer Energiewirtschaft and Sulzer Brothers, Ltd. refs

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Results are reported from wind-tunnel studies using a 10 x 11 in-line array of acrylic-rod tubes and water-channel studies using a 10 x 5-tube array (with a transverse standing free-surface wave simulating the acoustic mode of the wind tunnel). The data are presented in extensive graphs, flow-visualization photographs, and tables and characterized in detail. Antisymmetric vortex formation is observed in the tube wakes and attributed to the instability of the jet emerging between the tubes. The flow structure under resonant conditions, however, is found to be entirely different, with resonances attributed to coupling between the resonant sound field and unstable shear layers separating from the tubes. The mechanisms involved in the transition between jet and shear-layer instability modes are explored. T.K.

A92-43068**A METHOD FOR SOLVING THE 2-DIMENSIONAL POTENTIAL FLOW AROUND THIN CURVED PROFILES**

P. LAMPART and Z. WIERCINSKI (Polish Academy of Sciences, Institute of Fluid-Flow Machinery, Gdansk, Poland) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 364-T 369. refs

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Numerical solutions to a perfect fluid steady flow around a single-surface curved profile are obtained using the method of continuous vorticity distribution on a profile arc. The Kutta condition at the leading edge or a value of circulation around the profile are imposed, and interesting solutions are obtained. A proposal is made for extending a steady model toward steady separated flows. C.D.

A92-43617**A MULTIGRID METHOD FOR STEADY INCOMPRESSIBLE NAVIER-STOKES EQUATIONS BASED ON FLUX DIFFERENCE SPLITTING**

E. DICK (Ghent, State University, Belgium) and J. LINDEN (Gesellschaft fuer Mathematik und Datenverarbeitung mbH, St. Augustin, Federal Republic of Germany) International Journal for

Numerical Methods in Fluids (ISSN 0271-2091), vol. 14, no. 11, June 15, 1992, p. 1311-1323. refs
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The steady Navier-Stokes equations in primitive variables are discretized in conservative form by a vertex-centered finite volume method. Flux difference splitting is applied to the convective part to obtain an upwind discretization. The diffusive part is discretized in the central way. In its first-order formulation, flux difference splitting leads to a discretization of so-called vector positive type. This allows the use of classical relaxation methods in collective form. An alternating line Gauss-Seidel relaxation method is chosen here. This relaxation method is used as a smoother in a multigrid method. The components of this multigrid method are: full approximation scheme with F-cycles, bilinear prolongation, full weighting for residual restriction and injection of grid functions. Higher-order accuracy is achieved by the flux extrapolation method. In this approach the first-order convective fluxes are modified by adding second-order corrections involving flux limiting. Here the simple MinMod limiter is chosen. In the multigrid formulation the second-order discrete system is solved by defect correction. Computational results are shown for the well-known GAMM backward-facing step problem and for a channel with a half-circular obstruction. Author

A92-44352

CONVECTION-INDUCED SHEARS FOR GENERAL PLANFORMS

J. M. MASSAGUER (Cataluna, Universidad Politecnica, Barcelona, Spain), E. A. SPIEGEL (Columbia University, New York), and J.-P. ZAHN (Observatoire Midi-Pyrenees, Toulouse, France) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 7, July 1992, p. 1333-1335. Research supported by DGI/CYT. refs
(Contract AF-AFOSR-89-0012)
Copyright

Convection drives horizontal shearing modes with horizontal vorticity. For two-dimensional convection, these modes arise in a secondary bifurcation at a high Rayleigh number. When the convection is fully three dimensional, this shear arises at onset in an imperfect bifurcation with a parameter measuring the three-dimensionality as the imperfection parameter. Author

A92-44395

ROTATIONAL TEMPERATURE MEASUREMENTS IN AN ARC JET

G. CERNOGORA, G. GOUSSET, L. HOCHARD (Paris XI, Universite, Orsay, France), M. DUDECK, P. LASGORCEIX, and V. LAGO (CNRS, Laboratoire d'Aerothermique, Meudon, France) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 561-563. Research supported by CNRS. refs
Copyright

A low pressure arcjet is used to create high temperatures and high speed flows in the simulation of flow conditions around a space vehicle during its hypersonic atmospheric reentry. Here, a new optical emission spectroscopy method for measuring temperature from high resolution spectra in such low pressure arcs is presented. The possibility of tuning the arc temperature is demonstrated. C.D.

A92-44801

ON THE DEVELOPMENT OF GOERTLER VORTICES IN WALL JET FLOW

P. D. WADEY (British Aerospace /Space Systems/, Ltd., Stevenage; Exeter, University, England) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 26, no. 2, May 1992, p. 297-313. Research supported by SERC. refs
Copyright

The development of Goertler vortices in wall jet flow over curved surfaces is considered in both the linear and nonlinear growth regimes. It is shown, using asymptotic methods based on the largeness of the wavenumber of the vortices, that this hydrodynamic instability is prone to occur more readily on concave rather than convex surfaces. It is found that after passing the position of

neutral stability, the flow develops a surprising structure quite unlike that produced in the Blasius boundary-layer. Once the flow is into the unstable regime, the effect of increasing the Goertler number is to move the vortices away from the wall. Author

A92-45089

HELICITY IN LAMINAR AND TURBULENT FLOW

H. K. MOFFATT (Cambridge, University, England) and A. TSINOBER (Tel Aviv University, Israel) IN: Annual review of fluid mechanics. Vol. 24. Palo Alto, CA, Annual Reviews, Inc., 1992, p. 281-312. refs
Copyright

A general theoretical review of helicity in flows that are laminar or turbulent is presented with references to corresponding experimental investigations. The topological nature of the helicity invariant is examined, and the turbulent dynamo mechanism is discussed in relation to the phenomenon of helicity. Helicity is also discussed in terms of being a topological constraint in relaxation to equilibrium, and attention is given to the structure of turbulence and the suppression of nonlinearity. Observational and experimental data related to helical structures are reviewed including the generation of helicity in helicity-free flows, quantitative measurements of helicity, and the application of helicity density as a pseudoscalar quantity for characterizing complex 3D flows. Other topics of significance are addressed including skew diffusion, the AKA effect, and relaxation under modified Euler equation evolution. C.C.S.

A92-45091

WAVELET TRANSFORMS AND THEIR APPLICATIONS TO TURBULENCE

MARIE FARGE (Ecole Normale Supérieure, Paris, France) IN: Annual Review of Fluid Mechanics. Vol. 24. Palo Alto, CA, Annual Reviews, Inc., 1992, p. 395-457. refs
Copyright

A general description of continuous vs discrete wavelet transform is given emphasizing their use in the study of turbulence, and diagnostic methods are described based on wavelet coefficients. Attention is given to the need for a space-scale decomposition of turbulent flows and to the principles of wavelet transform. An analyzing function must have an average that is zero to be called a wavelet, and wavelets must be mutually similar, invertible, and regular. Continuous wavelet transform is described in terms of its analysis and synthesis, and the main properties of this process include linearity, covariance by translation and dilation, energy conservation, and space-scale locality. Comparison is made to the process of discrete wavelet transform which uses quasiorthogonal wavelet frames and interpolation. Wavelet applications to turbulence reviewed in the paper encompass energy decomposition, turbulence diagnostics, space-scale anisotropy, and turbulence computing and modeling methods. C.C.S.

A92-45093

HYDRODYNAMIC INSTABILITIES AND TURBULENCE - THE APPROACH AT CEA-DAM [INSTABILITES HYDRODYNAMIQUES ET TURBULENCE - LEUR APPROCHE AU CEA-DAM]

L. DAGENS (CEA, Centre d'Etudes de Limeil-Valenton, Villeneuve-Saint-Georges, France) and B. SITT (CEA, Centre d'Etudes de Vaujours-Moronvilliers, Courtry, France) CHOCS (ISSN 1157-741X), no. 2, June 1991, p. 7-25. In French. refs
Copyright

An approach is described for studying turbulent instability which incorporates conceptual, numerical, and experimental techniques. The paper reviews absolute and convective instabilities, and attention is given to the methods for studying arbitrarily small perturbations. Theoretical considerations related to the linear and nonlinear phases are set forth, and the Rayleigh-Taylor instability is illustrated. A statistical approach to the turbulent phase is then outlined emphasizing the characteristics of incompressible turbulence and the kinetic energy spectrum of stationary incompressible homogeneous isotropic turbulence. Also discussed in the paper are the transition phase and the experimental

verification of numerical results. The present approach is shown to be effective for studying the role of turbulence, and the importance of understanding the turbulent transition is confirmed.

C.C.S.

A92-45094

MODELLING COMPRESSIBLE TURBULENT MIXING [MODELISATION DES MELANGES TURBULENTS COMPRESSIBLES]

M. BONNET and S. GAUTHIER (CEA, Centre d'Etudes de Limeil-Valenton, Villeneuve-Saint-Georges, France) CHOCs (ISSN 1157-741X), no. 2, June 1991, p. 40-56. In French. refs

Copyright

A K-epsilon statistical model of turbulence is presented and applied to the flow in a shock tube in which the turbulence is generated primarily by the pressure gradient associated with the passage of a shock wave. A one-dimensional model is employed to describe the related physical processes, and a 2D extension is used that employs the Kelvin-Helmholtz formulation for instabilities caused by turbulent shear. The statistical models are used to quantitatively describe the transition to turbulence, and direct simulation with Navier-Stokes method is employed to discretize the flows in time and in space. A pseudospectral numerical method is utilized to simulate the Kelvin-Helmholtz instabilities, and the technique is shown to establish laws of scale that can be used to initialize the turbulence by means of the 2D extension of the K-epsilon model.

C.C.S.

A92-45095

A SPECTRAL MODEL FOR TURBULENT TRANSPORT [UN MODELE SPECTRAL DE TRANSPORT DE LA TURBULENCE]

D. BESNARD (CEA, Centre d'Etudes de Limeil-Valenton, Villeneuve-Saint-Georges, France), F. H. HARLOW, R. M. RAUENZAHN, and C. ZEMACH (Los Alamos National Laboratory, NM) CHOCs (ISSN 1157-741X), no. 2, June 1991, p. 57-69. In French. refs

Copyright

The paper details the numerical development of a spectral model for turbulence in the case of nonhomogeneous flow that is based on the K-epsilon family of models. The model is related the Navier-Stokes equations to the K-epsilon model by proposing that: (1) the scaling characteristic of the turbulence is slightly ahead of the flow medium; (2) the evolution of the flow medium is slower than that of the dominant vortices of the turbulence; and (3) the Reynolds number is sufficient so that an inertial zone exists in the turbulence spectra. Illustrations are presented of the self-similar spectra generated by the model, and the results are compared to those of a model based on nonlocal theory. The present numerical spectral model is shown to be valuable for analyzing turbulent transport by means of mechanisms that can be verified experimentally.

C.C.S.

A92-45603

DISCRETE-PHASE EFFECTS ON THE FLOW FIELD OF A DROPLET-LADEN SWIRLING JET WITH RECIRCULATION - A NUMERICAL STUDY

J. S. ANAGNOSTOPOULOS and G. C. BERGELES (Athens, National Technical University, Greece) International Journal of Heat and Fluid Flow (ISSN 0142-727X), vol. 13, no. 2, June 1992, p. 141-150. Research supported by EEC. refs

Copyright

A numerical algorithm based on the Lagrangian approach for the discrete phase and on the Eulerian for the continuous phase has been developed and used to predict a two-phase, droplet-laden swirling jet flow in a quail geometry. The gas-phase equations are discretized using finite difference principles and are solved with the aid of the SIMPLE algorithm. The dispersion of the discrete phase is simulated using a stochastic separated flow model. After the reliability tests, the method is used to quantify the effects of droplet size, droplet loading, and swirl intensity on the carrier phase internal recirculation region and on the dispersion of droplets. The results indicate that the amount of recirculating mass increases with the droplet diameter and the decreases of loading. For high

loadings and swirl the internal recirculation region breaks down and it is divided into two subregions. Small droplets are dispersed following the gas phase, while large droplets are affected mainly by their injection conditions.

Author

A92-45704

INTERACTIONS OF AN ELASTIC SOLID WITH A VISCOUS FLUID - EIGENMODE ANALYSIS

R. M. S. SCHULKES (Delft University of Technology, Netherlands) Journal of Computational Physics (ISSN 0021-9991), vol. 100, no. 2, June 1992, p. 270-283. Previously announced in STAR as N91-15508. refs

Copyright

The interaction of a viscous fluid with an elastic solid is studied. Of particular interest are the eigenmodes of the coupled system. Starting from the Navier-Stokes equations for the fluid and the linear elasticity equations for the solid, the linear equations governing the motion of the system are derived. It is shown how a variational formulation of the problem may be obtained by re-scaling the displacement unknowns. The finite element technique is then used to discretize the equations. The resulting quadratic eigenvalue problem is solved using an inverse iteration procedure.

Author

A92-46254

SPECTRAL LARGE-EDDY SIMULATION OF ISOTROPIC AND STABLY STRATIFIED TURBULENCE

OLIVIER METAIS and MARCEL LESIEUR (Grenoble, Institut National Polytechnique; Grenoble I, Universite, France) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 239, June 1992, p. 157-194. Research supported by CNRS. refs

(Contract DRET-87-238)

Copyright

The paper presents the spectral large-eddy and direct numerical simulations of decaying turbulence, showing that, in the decaying turbulence, a convected passive scalar displays several anomalous characteristics. These include a $1/k$ spectrum at large scales, a $\ln k$ eddy diffusivity, a large-scale intermittency with exponential probability density functions, and decay laws which are much stronger than the ones predicted by statistical theories of turbulence or those observed in some grid-turbulence experiments. The presence of stable stratification leads to coupling between temperature and velocity fields, resulting in a greatly modified temperature behavior. As a consequence, the average decay rate for the available potential energy is now comparable to the 'turbulent' velocity component decay rate.

I.S.

A92-46260

MELTING AND DISSOLVING

ANDREW W. WOODS (Cambridge, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 239, June 1992, p. 429-448. Research supported by Green Foundation. refs

Copyright

The different modes of convection which may arise in diffusion-governed melting of a pure solid into a binary melt, when the interface between the solid and the melt is horizontal are investigated. It is shown that, in the dissolving regime, a relatively warm solid may dissolve into a relatively cold liquid. The nature of the convection which may arise as the geometry and the melt composition are varied is determined by calculating the difference between the density of the melt at the solid interface and the density of the liquid far from the interface. The analysis is generalized by considering binary solid solutions.

I.S.

A92-46261

DIRECT SIMULATION MONTE CARLO CALCULATIONS OF RAREFIED FLOWS WITH INCOMPLETE SURFACE ACCOMMODATION

R. G. LORD (Oxford, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 239, June 1992, p. 449-459. refs

Copyright

Effects of incomplete surface accommodation in rarefied gas

flows have been studied using the direct simulation Monte Carlo (DSMC) method in conjunction with the Cercignani-Lampis gas-surface interaction model. Two different flows have been studied, both of which have previously been simulated in DSMC calculations for the case of complete surface accommodation. These are (1) the flow over a sharp, slender circular cone at Mach 5.1 and (2) the flow over a flat-faced circular cylinder at Mach 25. In each case, the gas simulated was nitrogen. It was found that in case (1) the accommodation coefficient of the kinetic energy due to the tangential component of velocity has the greatest influence, whereas in case (2) that of the normal component is also important, having a drastic effect on the rarefied flowfield.

Author

A92-46265

THE NONLINEAR STABILITY OF FLOWS OVER COMPLIANT WALLS

M. D. THOMAS (Warwick, University, Coventry, England) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 239, June 1992, p. 657-670. Research supported by SERC. refs

Copyright

The weakly nonlinear, high-Reynolds-number triple-deck theory of Smith (1979) is applied to Blasius flow over a compliant wall. Attention is concentrated on Tollmien-Schlichting (TS) disturbance waves. This paper considers wall models of the Carpenter-Garrad type, modified to cater for 3D disturbances, and allowing for the effects of nonlinear wall curvature. Supercritical equilibrium-amplitude states are possible for TS waves in a rigid-wall boundary layer, as is well known (for example, Smith 1979; Hall and Smith 1984). It is found that judicious choice of wall parameters can dramatically alter the nonlinear stability properties of TS waves in the boundary layer over a compliant wall: waves that are linearly damped may become nonlinearly unstable. Excellent agreement is obtained with rigid-wall results of Hall and Smith.

Author

A92-46442

NONLINEAR GALERKIN METHOD AND SUBGRID-SCALE MODEL FOR TWO-DIMENSIONAL TURBULENT FLOWS

FREDERIC PASCAL and CLAUDE BASDEVANT (CNRS, Laboratoire de Meteorologie Dynamique, Paris, France) *Theoretical and Computational Fluid Dynamics* (ISSN 0935-4964), vol. 3, no. 5, May 1992, p. 267-284. refs
(Contract DRET-90-1551-A000)

Copyright

The nonlinear Galerkin method, derived by Marion and Temam from results in dynamical systems theory, is investigated in the framework of numerical simulation of two-dimensional incompressible turbulent flows. The nonlinear Galerkin method together with a hyperviscosity subgrid-scale parametrization is used. The paper states the theoretical background, define the scheme, and derive some technical improvements for the method. Numerical experiments conducted for freely decaying as well as forced turbulence are also reported. The main conclusion is that the performance of the nonlinear Galerkin method is important only if the dissipation range is large.

Author

A92-46825

THE APPLICATION OF PARTICLE IMAGE VELOCIMETRY (PIV) IN A SHORT-DURATION TRANSONIC ANNULAR TURBINE CASCADE

P. J. BRYANSTON-CROSS, C. E. TOWERS, T. R. JUDGE, D. P. TOWERS (Warwick, University, Coventry, England), S. P. HARASGAMA, and S. T. HOPWOOD (Royal Aerospace Establishment, Propulsion Dept., Farnborough, England) *ASME, Transactions, Journal of Turbomachinery* (ISSN 0889-504X), vol. 114, no. 3, July 1992, p. 504-509. Previously announced in STAR as N91-28504. refs
(ASME PAPER 91-GT-221) Copyright

A series of experiments was performed to demonstrate the application of Particle Image Velocimetry to turbomachinery flows. The tests were performed at transonic speeds on a fully annular engine size turbine nozzle guide vane. The vane cascade was installed in a short duration Isentropic Light Piston Cascade (ILPC)

test facility operating with high inlet turbulence levels. The technique was shown to map the whole flow field with a resolution of 0.5 mm. The quality of the results obtained are not greatly affected by local turbulence rates. The accuracy of the measurements is put at around 4 pct. of absolute velocity and is limited by the quality of the image on the film plane. The velocities derived from the PIV images were compared with predictions from a 3-D viscous numerical calculation. It is shown that the experimental and predicted results are in good agreement. It is considered that this technique has considerable potential in application to turbomachinery flow field diagnostics.

Author

A92-46918

VISCOUS EDDIES OVER A GROOVED SURFACE COMPUTED BY A GAUSSIAN-INTEGRATION GALERKIN BOUNDARY-ELEMENT METHOD

P. LUCHINI, F. MANZO, and A. POZZI (Napoli, Universita, Naples, Italy) *AIAA Journal* (ISSN 0001-1452), vol. 30, no. 8, Aug. 1992, p. 2168-2170. refs

Copyright

Typical streamline patterns arising in Stokes flow across riblets and exhibiting viscous eddies are presented. Attention is given to the plotting of results obtained for sinusoidal, triangular, and parabolic groove profiles. The bound vortex is noted to be strongest in the parabolic case, and weakest in the triangular, as could be expected on the basis of wall conformation.

O.C.

A92-47056

SOLUTION OF THE TWO-DIMENSIONAL COMPRESSIBLE NAVIER-STOKES EQUATIONS ON EMBEDDED STRUCTURED MULTIBLOCK MESHES

J. SZMELTER, M. J. MARCHANT, A. EVANS, and N. P. WEATHERILL (Swansea, University College, Wales) IN: *Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 287-299. Research supported by CEC and Royal Aerospace Establishment. refs*

Copyright

A cell vertex finite volume Jameson scheme is used to solve the 2D compressible, laminar, viscous fluid flow equations on locally embedded multiblock meshes. The proposed algorithm is applicable to both the Euler and Navier-Stokes equations. It is concluded that the adaptivity method is very successful in efficiently improving the accuracy of the solution. Both the mesh generator and the flow equation solver which are based on a quadtree data structure offer good flexibility in the treatment of interfaces. It is concluded that methods under consideration lead to accurate flow solutions.

O.G.

A92-47070

APPLICATION OF A VARIATIONAL METHOD IN COMPRESSIBLE FLOW COMPUTATIONS

ABDELGHANI SAOUAB and DANY VANDROMME (Rouen, Institut National des Sciences Appliquees, Mont-Saint-Aignan, France) IN: *Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 557-567. refs*

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A variational method for grid optimization with application to complex flow calculations is reported. Good results using it are obtained in several 2D cases. The method can be naturally extended to 3D flows without special difficulty.

C.D.

A92-47157

UNSTRUCTURED MULTIGRIDDING BY VOLUME AGGLOMERATION - CURRENT STATUS

MARIE-HELENE LALLEMAND, HERVE STEVE, and ALAIN DERVIEUX (INRIA, Valbonne, France) *Computers & Fluids* (ISSN 0045-7930), vol. 21, no. 3, July 1992, p. 397-433. Research supported by DRET, INRIA, and CNES. refs

Copyright

A multigrid (MG) method for solving the Euler equations as applied to nonstructured meshes in two (triangles) and three dimensions (tetrahedra) is described. The main idea is to coarsen the given mesh by using topological neighboring relations. It is applied to upwind solvers relying on the MUSCL methodology. Two MG schemes are presented: an explicit Runge-Kutta FAS, and an implicit correction scheme. Transonic external flow computations are described for illustration. Author

A92-47676

THE TURBULENCE CHARACTERISTICS OF A SINGLE IMPINGING JET THROUGH A CROSSFLOW

J. M. M. BARATA, D. F. G. DURAO, M. V. HEITOR (Lisbon, Technical University, Portugal), and J. J. MCGUIRK (Loughborough University of Technology, England) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 4, July 1992, p. 487-498. Research supported by Ministry of Defence of England. refs Copyright

An experimental investigation of the flowfield generated by a single jet intersecting a crossflow is presented using laser-Doppler anemometry to characterize the effects of velocity ratio. An impingement height of 5 jet diameters is assumed, and the velocity ratio between the jet and the crossflow is determined at Reynolds numbers of 60,000-120,000 and velocity ratios of 30-73. The results are compared to those generated with a k-epsilon turbulence model to demonstrate the use of the experimental data for confirming the results of numerical methods. The turbulence models are shown to suffer from numerical diffusion errors that obfuscate the assessment of model performance. The laser-Doppler velocimeter can be used to describe the mean and turbulent velocity characteristics determined by the jet/crossflow configuration considered. C.C.S.

A92-47899#

A NUMERICAL SIMULATION OF INJECTION OF DROPLETS IN A COMPRESSIBLE FLOW

E. DANIEL, M. LARINI, J. C. LORAUD, and B. PORTERIE (Aix-Marseille I, Universite, Marseille, France) AIAA, Thermophysics Conference, 27th, Nashville, TN, July 6-8, 1992. 9 p. Research supported by Direction des Constructions Navales. refs

(AIAA PAPER 92-2929) Copyright

The injection of water droplets in an inviscid compressible flow is computed. The 2D equations are established by using a two-fluid (or Eulerian-Eulerian) model, and solved with the Mac-Cormack finite difference scheme. Heat, mass and drag transfer between the two phases are taken into account. Classical results in a nozzle are first presented in a subsonic flow. Then a calculation of droplet injection is made: this injection occurs in a subsonic one-phase flow. Author

A92-48200

DIRECT ESTIMATES OF UNIVERSAL MULTIFRACTAL INDICES FOR WIND AND TEMPERATURE FIELDS [ESTIMATIONS DIRECTES DES INDICES DE MULTIFRACTALS UNIVERSELS DANS LE CHAMP DE VENT ET DE TEMPERATURE]

FRANCOIS SCHMITT, DANIEL LAVALLEE, SHAUN LOVEJOY, DANIEL SCHERTZER, and CHARLES HOOGE (Meteorologie Nationale, Centre National de Recherche Meteorologique, Paris, France; McGill University, Montreal, Canada) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de la Terre et de l'Univers (ISSN 0764-4450), vol. 314, no. 8, April 9, 1992, p. 749-754. In French. refs (Contract DE-FG03-90ER-61062) Copyright

The Levy indices for wind and atmospheric temperature data are determined by means of the double-trace moment technique to examine the multifractal nature of wind and temperature. The velocity and temperature measurements used for the data sets are described, and the trace-moment equation is applied to the flux densities for various orders. Turbulence exhibits a behavior between lognormal multifractal and beta model monofractal. Since

the alpha value is at least 1, the turbulence is shown to be an unconditionally hard multifractal process, and the intermittency parameter for wind turbulence is revised and set at 0.35 ± 0.1 . The present results are in agreement with empirical determinations of intermittency from wind-tunnel and atmospheric-temperature data. C.C.S.

A92-48203

COMPUTATION OF THE FLOW AND HEAT TRANSFER DUE TO A ROTATING DISC

C. L. ONG and J. M. OWEN (Sussex, University, Brighton, England) International Journal of Heat and Fluid Flow (ISSN 0142-727X), vol. 12, no. 2, June 1991, p. 106-115. Research supported by SERC, Rolls-Royce, PLC, and Ruston Gas Turbines, PLC. refs Copyright

The boundary-layer momentum and energy equations have been solved numerically using a Keller-box scheme and, for turbulent flow, an eddy-viscosity model. The numerical method has been successfully validated on a number of standard test cases for unheated disks, including data for velocity profiles and moment coefficients in both laminar and turbulent flow, and some old and new test cases for heated disks, including average and local Nusselt numbers for a range of disk-temperature distributions and for Reynolds numbers up to 3.2×10^6 . The method is shown to be sufficiently simple, efficient, and accurate for all practical purposes. Author

A92-48206

AN INTEGRAL CALCULATION METHOD FOR INCOMPRESSIBLE THREE-DIMENSIONAL BOUNDARY LAYERS IN AXISYMMETRIC DIFFUSERS

F. T. F. MORGADO (TAP Air Portugal, Lisbon) and L. M. C. GATO (Lisbon, Technical University, Portugal) International Journal of Heat and Fluid Flow (ISSN 0142-727X), vol. 12, no. 2, June 1991, p. 150-157. Research supported by Instituto Nacional de Investigacao Cientifica. refs Copyright

A direct integral method is presented for the calculation of incompressible turbulent three-dimensional boundary layers in axisymmetric walls. An inviscid throughflow program was combined with the boundary-layer calculation method to predict swirling flows in annular diffusers. Comparison between theoretical and experimental results indicates that predictions can be made in a greater variety of boundary-layer flows with interest in turbomachinery. A design criterion based on boundary-layer development was used to compute the wall shape of axisymmetric diffusers. Author

A92-48254

LAMINAR CHANNEL FLOW OVER A SQUARE STEP

H. S. ONUR and E. BAYDAR (Karadeniz Technical University, Trabzon, Turkey) International Journal of Engineering Science (ISSN 0020-7225), vol. 30, no. 9, Sept. 1992, p. 1109-1116. refs Copyright

The structure of laminar channel flow over a square step was studied experimentally and numerically for Reynolds numbers up to 800. Experimental work consisted of flow visualization, successive photographing and hot wire velocity measurements. Flow visualization showed that the flow lost its two-dimensionality and steadiness after the step. Five distinct flow regions, some of which occurring periodically were identified. Two-dimensional steady state numerical predictions were in good agreement with the hot wire velocity measurements at locations where the flow was steady and two-dimensional. Author

A92-48604

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF A HOMOGENEOUS TURBULENT SHEAR FLOW

O. LEUCHTER, J. P. BENOIT (ONERA, Chatillon, France), J. P. BERTOGLIO (Lyon, Ecole Centrale, Ecully, France), and J. MATHIEU (ONERA, Chatillon, France) ONERA, TP no. 1992-43,

1992, 11 p. refs
(Contract DRET-89-001)
(ONERA, TP NO. 1992-43) Copyright

A new configuration of homogeneous turbulent shear flow is investigated experimentally and numerically. The flow is created by superposition of plane strain and solid body rotation of equal rates. This provides uniform shear in planes perpendicular to the main flow direction. The evolution of the Reynolds stresses and associated integral length scales are determined by hot-wire measurements. The shear gives rise to a definite decrease of the turbulent energy decay and a pronounced anisotropization of the Reynolds stresses and length scales, as compared to the evolution without shear. The experimental results are compared with numerical predictions based on a two-point closure approach of the EDQNM type. The numerical results are in good qualitative agreement with the measurements, especially for the evolution of the length scales. Author

A92-48616 NAVIER-STOKES COMPUTATION OVER A THREE-DIMENSIONAL RAMP

C. JOUET and M. BORREL (ONERA, Chatillon, France) (INRIA, Workshop on Hypersonic Flow, Antibes, France, Apr. 1991)
ONERA, TP no. 1992-55, 1992, 12 p. refs
(ONERA, TP NO. 1992-55)

A Navier-Stokes computation over a 3D obstacle conducted with the NS code FLU3M is presented. The mesh refinement at the leading edge is determined to be critical for an accurate prediction of heat fluxes. The comparison with experiment shows a greater separation area for the computation and the levels of the Stanton number profiles are underestimated. R.E.P.

A92-48619 MODELING OF A VORTEX IN TURBULENT INCOMPRESSIBLE FLOW (MODELISATION D'UN TOURBILLON EN Ecoulement TURBULENT INCOMPRESSIBLE)

PH. PASCAL (Journée sur les Ecoulements Tourbillonnaires et Methodes Numeriques, Saint-Pierre-de-Chartreuse, France, June 15-19, 1992) ONERA, TP no. 1992-60, 1992, 24 p. In French. refs
(ONERA, TP NO. 1992-60)

Two methods for calculating axisymmetric turbulent vortical flow are presented. Use of the Navier-Stokes code has allowed a theoretical evaluation of the effect of turbulence on the stability of the vortex subjected to a pressure gradient. Comparing calculated results with experimental data provides adequate verification between the two methods as well as the trends of the vortex models. R.E.P.

A92-49016# PREDICTION OF GAS TURBINE COMBUSTOR FLOW BY A FINITE ELEMENT CODE

D. LENTINI, C. FELIZIANI, P. IONTA, and F. RISPOLI (Roma I, Università, Rome, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 12 p. Research supported by ASI. refs
(AIAA PAPER 92-3469) Copyright

A finite element computer code for gas turbine combustor flows, currently under development, is presented which aims at an improved grid flexibility, a reduced numerical diffusion by using the SUPG (Streamline Upwind/Petrov-Galerkin) formulation, and at a detailed representation of the chemistry-turbulence interaction. Both an equilibrium model and a finite-rate model have been developed. The models make it possible to reduce the computer time by a factor of about ten. An application to a 2D flow in a gas turbine combustor, with equilibrium chemistry, is reported to show the workability of the proposed code. Author

A92-49511 NUMERICAL SIMULATION OF JET-FORCED FLOW IN A CIRCULAR RESERVOIR USING DISCRETE AND RANDOM VORTEX METHODS

A. G. L. BORTHWICK (Oxford, University, England) and R. W.

BARBER (Salford, University, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 14, no. 12, June 30, 1992, p. 1453-1472. Research supported by SERC. refs

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This paper describes a Biot-Savart discrete vortex model for simulating the flow patterns which occur when a single high-velocity inflow jet is used to stir the fluid within a circular container. The first stage of the model consists of conformally mapping the circular perimeter of the container onto a rectangle by means of a Schwarz-Christoffel transformation. A potential flow solution is then obtained for the flow inside the rectangle and this is transformed to give the potential flow inside the circle. In the second stage of the simulation, discrete vortices are added at the inlet of the physical system in order to model the inflow shear layers. Velocity components resulting from the discrete vortices and their images in the walls of the cylinder are superimposed on the uniform potential flow solution. The positions of the vortices are updated using a Lagrangian tracking procedure. Viscous effects are incorporated through the use of random walks. From the results it is shown that the discrete vortex method does predict qualitatively the important features of jet-forced reservoir flow. Author

A92-49516 NAVIER-STOKES COMPUTATIONS OF HORSESHOE VORTEX FLOWS

G. B. DENG and J. PIQUET (Ecole Nationale Supérieure de Mécanique, Nantes, France) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 15, no. 1, July 15, 1992, p. 99-124. refs

(Contract DRET-86-104; DRET-89-117)

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Computation of the incompressible 3D turbulent viscous flow about an aerofoil/flat plate junction is reviewed. An iterative, fully decoupled technique is applied to the Reynolds-averaged Navier-Stokes equations written in a nonorthogonal curvilinear body-fitted coordinate system. The existing experimental databases are used to compare the numerical outputs of the computational method with experimental results involving massive separation. O.G.

A92-50086 FINITE VOLUME SOLUTION OF THE INVISCID COMPRESSIBLE FLUID FLOW

JIRI FELCMAN (Charles University, Prague, Czechoslovakia) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vorträge. A92-50078 21-31) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 6, 1992, p. T 513-T 516. refs

Copyright

A numerical method is described for simulating 2D inviscid compressible fluid flow in a channel or in a region around a profile. A finite volume flux vector splitting scheme of the Godunov type is used to treat the hyperbolic problem. A brief description of the boundary conditions of the problem is presented along with a comparison of numerical results computed with the Euler and the potential flow models. C.D.

A92-50108 FROM VORTEX LAYERS TO VORTEX SHEETS

D. BENEDETTO (L'Aquila, Università, Italy) and M. PULVIRENTI (Roma II, Università, Rome, Italy) SIAM Journal on Applied Mathematics (ISSN 0036-1399), vol. 52, no. 4, Aug. 1992, p. 1041-1056. refs

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This paper shows that the solution of the Birkhoff-Rott equation for the vortex sheet can be approximated, for short times, by the solutions of the Euler equation for a thin vortex layer of vorticity, when its thickness vanishes and its vorticity intensity diverges suitably. The result is obtained in an analytical setup, and an example seems to indicate that this is indeed necessary. Author

A92-50297

IMPINGEMENT OF AN AXISYMMETRIC JET ON UNHEATED AND HEATED FLAT PLATES

I. B. OZDEMIR and J. H. WHITELAW (Imperial College of Science, Technology, and Medicine, London, England) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 240, July 1992, p. 503-532. Research supported by Ford Motor Co., Ltd. refs
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The aerodynamic and thermal characteristics of a wall jet flow formed as a result of the angled impingement of an axisymmetric jet are investigated experimentally to gain a better understanding of the consequences of the impingement of fuel sprays on the cylinders of internal combustion engines, in particular the wall-wetting phenomenon. It is found that the radial wall flow field formed after the angled impingement of a round turbulent jet depends on the impingement angle, with a sudden change of the orientation of the surface pressure contours at an angle of 40 deg. The Nusselt number has an azimuthal dependence in accordance with the variation of the surface temperature, which exhibits a sudden change at an angle of 40 deg in parallel with the dynamics of the flow in the close vicinity of the wall. V.L.

A92-50477

ILL-POSEDNESS OF A SHOCK-FITTING PROBLEM FOR PARABOLIZED NAVIER-STOKES EQUATIONS

Y. BOURGAULT and P. CAUSSIGNAC (Lausanne, Ecole Polytechnique Federale, Switzerland) *European Journal of Mechanics, B/Fluids* (ISSN 0997-7546), vol. 11, no. 3, 1992, p. 309-315. refs
(Contract SNSF-20,005404,87)
Copyright

In the past, a shock-fitting approach has been used in supersonic flow computation based on Parabolized Navier-Stokes (PNS) equations. In this paper, it is shown that the associated shock-fitting problem is ill-posed for PNS equations. The proof rests on the fact that four Rankine-Hugoniot relations are provided at the shock but that four boundary conditions should be imposed there, too. Author

A92-51891

A SUBCLASS OF VISCOELASTIC FLUIDS CONNECTED WITH ADMISSIBLE VON KARMAN SOLUTIONS

V. TIGOIU and AN C. HO (Bucharest, University, Romania) *Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee* (ISSN 0035-4074), vol. 37, no. 1, Jan.-Feb. 1992, p. 3-19. refs

Two problems, i.e., the flow between parallel disks and the flow between parallel plates, are treated to determine if von Karman's solutions are admissible for third-grade viscoelastic fluids. It is demonstrated that a general third-grade viscoelastic fluid cannot experience a von Karman flow, but this is possible for a particular subclass. The two aforementioned problems are solved for such a fluid, and it is shown that it is possible to obtain a formula for the determination of the constitutive modulus. L.M.

A92-51892

ORGANIZED STRUCTURES IN THE DEVELOPING REGION OF AXI-SYMMETRIC JET FLOW

D. MARTIS and N. SAVULESCU (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Romania) *Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee* (ISSN 0035-4074), vol. 37, no. 1, Jan.-Feb. 1992, p. 21-28. refs

Theoretical and empirical criteria for the existence of a cellular structure in the x/d sub 0 = 10-40 range of a jet flow are presented. Experiments were performed in an anechoic chamber, the outlet flow having Rd sub 0 = 80,000 and a relative turbulence intensity of 0.13 percent. L.M.

A92-51893

SOME PROBLEMS OF THE STABILITY OF A SYSTEM OF THREE VORTICES [QUELQUES PROBLEMES DE STABILITE D'UN SYSTEME DE TROIS TOURBILLONS]

P. CAPODANNO (Franche-Comte, Universite, Besancon, France)

Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (ISSN 0035-4074), vol. 37, no. 1, Jan.-Feb. 1992, p. 29-38. In French. refs

The stability of the invariable configurations of a system of three vortices is investigated using the direct Liapunov method. Particular attention is given to the stability of aligned configurations and to the existence and stability of equilateral configurations. L.M.

A92-52404

ADAPTIVE SPECTRAL METHODS WITH APPLICATION TO MIXING LAYER COMPUTATIONS

H. GUILLARD (INRIA, Valbonne, France), J. M. MALE, and R. PEYRET (Nice, Universite; INRIA, Valbonne, France) *Journal of Computational Physics* (ISSN 0021-9991), vol. 102, no. 1, Sept. 1992, p. 114-127. refs
(Contract DRET-89-174)
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Self-adaptive Chebyshev spectral methods are presently used to compute mixing layers at subsonic convective Mach number over different extents of the domain, thereby allowing (1) the use of a manageable number of collocation points and (2) an accurate following of layer behavior. A survey is conducted of the functionals proposed by various authors, and a novel interpretation of the functional given by Bayliss et al. (1989) is described. While there are no significant differences in the results obtained with different functionals, the computation of the functional has been found to be sensitive to careless approximations. The importance of filtering the argument of the functional is noted. O.C.

A92-52722

BROWNIAN-MOTION LIMITED AERODYNAMIC FOCUSING OF HEAVY MOLECULES

R. FERNANDEZ-FERIA, P. RIESCO-CHUECA (E.T.S.I.I., Seville, Spain), J. ROSELL-LLOMPART, J. O'BRIEN, and J. FERNANDEZ DE LA MORA (Yale University, New Haven, CT) *IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 214-221. refs*
(Contract DE-FG02-87ER-13750; NSF CBT-88-12070; NSF CBT-88-09548; DAAL03-87-K-0127)
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Thermal agitation is the major phenomenon limiting how narrowly a beam of heavy molecules suspended in a light carrier gas can be focused by acceleration through a converging nozzle. Here, the problem is studied numerically by two different methods: hypersonic theory and Brownian dynamics simulation, with a good agreement between both. A near-axis simplification of the hypersonic equations yields the focusing characteristics of inviscid two-dimensional flows in nozzles with straight walls converging at various angles. Author

A92-52724

SHOCK WAVE PROPAGATION IN A RANDOM (TURBULENT) RAREFIED FLOW

IDA BONZANI (Torino, Politecnico, Turin, Italy) *IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 232-238. Research supported by CNR and Ministry for Scientific Research of Italy. refs*

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This paper deals with the analysis of the nonlinear shock wave problem in a one dimensional turbulent medium by the discrete Boltzmann equation. The first order probability density is derived and computed for steady and unsteady profiles. Author

A92-52785

SHOCK-WAVE ONSET WITH CHEMICAL DISSOCIATION BY THE DISCRETE BOLTZMANN EQUATION

ROBERTO MONACO and MIRIAM PANDOLFI BIANCHI (Torino, Politecnico, Turin, Italy) *IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14,*

1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 862-869. Research supported by CNR and Ministry for Scientific Research of Italy. refs
Copyright

This paper deals with the analysis of formation and evolution of 1D shock-waves in the framework of discrete kinetic theory of gases with chemical reactions. In particular, a model of the discrete Boltzmann equation which takes into account chemical reactions of molecule dissociation is proposed. The study of shock-wave formation leads to an initial value problem for a set of nonlinear PDEs which is numerically solved by means of a finite difference method. Author

A92-52794

FREE MOLECULAR PRESSURE PROBE MEASUREMENTS IN THE CONTINUUM, TRANSITIONAL AND FREE MOLECULAR REGIMES OF A FREE JET

J.-T. MEYER (DLR, Institut fuer Experimentelle Stromungsmechanik, Goettingen, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 963-970. refs
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An experimental investigation was carried out to find a criterion for the formation of the Mach-disk in a free-jet expansion into a vacuum, using an expansion chamber in which the background gas level was adjusted from a very low level (by means of a cryopump) to a very high level (by means of artificial leakage). The particle-flux density was measured using a free molecular pressure probe. The criterion for the shock formation was derived by correlating the empirical Mach-disk location and the distance of the freezing surface. I.S.

A92-52814

ENTROPY PRODUCTION IN GASEOUS BOUNDARY LAYERS

IVAN KUSCER (Ljubljana, University, Yugoslavia) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1311-1317. Research supported by Research Foundation of Slovenia. refs
Copyright

Entropy production in nonequilibrium gases is evaluated either from the solution of the Boltzmann equation, or intuitively by expressing the dissipation in terms of thermodynamic fluxes and forces. The equivalence of both approaches, which for the hydrodynamic regime is well established, is extended here to the boundary layers in a wide plane gap. Author

A92-53052

INSIGHT INTO SINGULAR VORTEX FLOWS

GIANNI PEDRIZZETTI (Firenze, Universita, Florence, Italy) Fluid Dynamics Research (ISSN 0169-5983), vol. 10, no. 2, Aug. 1992, p. 101-115. Research supported by MURST. refs
Copyright

The method of three-dimensional vortex singularities is analyzed. The fact that it does not represent a weak solution of the Euler equations has little bearing on its validity as an operative model. Other evolution inconsistencies are a major problem. The non-solenoidality of the vortex field is analyzed and a linear filtering feedback procedure, requiring no additional computations, is introduced to allow alignment with the reconstructed solenoidal vorticity field. A rough estimation of the dissipative effect during vortex reconnection has shown a finite viscous effect that is implicitly present in the model, growing with stretching, representing the mechanism of shifting to reconnected topologies without observing strong velocity gradients. The dividing vorton method is rearranged in order to allow the quantized reproduction of a predefined core evolution law, an error estimation, due to the corpuscularity of the field, is given. Two different numerical computations are performed corresponding to a weak and a strong vortex interaction. The improvements are tested, and confrontations with existing numerical and experimental results are performed

showing good agreement. The possibility of the singular vortex flow serving as a rough, but simple, model for very high Reynolds number complex flows is discussed. Author

A92-53124

ON MISSING BOUNDARY CONDITIONS WITH UNSTEADY INCOMPRESSIBLE NAVIER-STOKES FLOWS

F. K. HEBEKER (IBM Scientific Center, Heidelberg, Germany) and P. WILDE (Aeronautical Research Institute of Sweden, Bromma) Mathematical Methods in the Applied Sciences (ISSN 0170-4214), vol. 15, no. 6, Aug. 1992, p. 421-432. Research supported by STU. refs
Copyright

An unsteady viscous flow problem where 'good' boundary conditions are available on part of the boundary only is investigated. This problem appears when the flow phenomena are concentrated on part of the flow region and, for reasons of computational economy, are numerically computed in this subregion only. Assuming that outside of the subregion the flow is not subjected to any acceleration forces, an (abstract) combined finite-element/boundary element scheme is developed to compute the flow approximately. This scheme leads to a proof of the existence of a weak solution of the corresponding Navier-Stokes problem. Author

A92-54487

THE STRUCTURE OF A TURBULENT FREE SHEAR LAYER IN A ROTATING FLUID

A. A. BIDOKHTI and D. J. TRITTON (Newcastle upon Tyne, University, United Kingdom) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 241, Aug. 1992, p. 469-502. refs
Copyright

The effects of rotation on the development and structure of turbulence in a free shear layer oriented so that its mean vorticity is parallel or antiparallel to the system vorticity was investigated experimentally. The quantitative results include the reorientation by Coriolis effects of the Reynolds stress tensor; changes in the ratio of spanwise to longitudinal intensities; a gradual decrease, with increasing stabilization, of the Reynolds shear stress leading ultimately to its change of sign; and an increase of the Reynolds shear stress in the destabilized range followed by rapid collapse to almost zero with restabilization. I.S.

A92-54488

STABILIZATION AND DESTABILIZATION OF TURBULENT SHEAR FLOW IN A ROTATING FLUID

D. J. TRITTON (Newcastle upon Tyne, University, United Kingdom) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 241, Aug. 1992, p. 503-523. refs
Copyright

Processes involved in a turbulent shear flow in a rotating fluid are investigated analytically for cases when the rotation axis is parallel or antiparallel to the mean flow vorticity. These processes are formulated in ways that permit direct comparison of the underlying concepts with experimental data. The 'simplified Reynolds stress equations scheme' proposed by Johnson et al. (1972) is reformulated in terms of two angles, representing the orientation of the principal axes of the Reynolds stress tensor α -a and the orientation of the Reynolds stress-generating processes α -b, which are approximately equal according to the scheme. It is shown that, although the scheme fails at large rotation rates, it can be applied to a wide range of cases which may be tested with experimental data. The values of α -a and α -b were evaluated using numerical data of Bertoglio (1982) for homogeneous shear flow, and laboratory data for a wake (Witt and Joubert, 1985) and a free shear layer (Bidokhti and Tritton, 1992). I.S.

A92-54963

NONPARALLEL-FLOW STABILITY OF AN AXISYMMETRIC BUOYANT PLUME IN A COFLOWING UNIFORM STREAM

M. TVEITEREID (Agder College of Engineering, Grimstad, Norway) and D. S. RILEY (Bristol, University, United Kingdom) Physics of

Fluids A (ISSN 0899-8213), vol. 4, no. 10, Oct. 1992, p. 2151-2161. refs

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Nonparallel effects of the basic flow and disturbances are included in a linear stability study of an axisymmetric thermal plume in a coflowing uniform stream. On invoking a slowly varying approximation and undertaking a multiple scale analysis, a larger region of stability than that predicted by parallel-flow theory is obtained. The amplification rate of the perturbation depends on the flow quantity under consideration and so there is no unique boundary between stable and unstable perturbations. The calculated critical Reynolds numbers for the perturbation velocities are, however, of the same order of magnitude, the lowest being 32.9 for a pure plume, and they increase significantly as the strength of the external stream increases. There are two mechanisms for instability: one is shear driven, the other gravitational. Author

A92-54971

ASYMPTOTIC EQUATIONS FOR THE STRETCHING OF VORTEX FILAMENTS IN A BACKGROUND FLOW FIELD

RUPERT KLEIN (Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany), ANDREW J. MAJDA, and RICHARD M. MCLAUGHLIN (Princeton University, NJ) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 10, Oct. 1992, p. 2271-2281. Research supported by DOE. refs

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Recently, Klein and Majda (1991) have derived and analyzed a new asymptotic equation for the evolution of small-amplitude short-wavelength perturbations of slender vortex filaments in high Reynolds number flows. This asymptotic equation differs significantly from the familiar local self-induction equation in that it includes some of the nonlocal effects of self-stretching of the filament in a simple fashion. Here, through systematic asymptotic expansions, a modification of this asymptotic equation is derived that incorporates the important additional effects of strain and rotation from a general background flowfield. The new asymptotic equations exhibit in a simple fashion the direct competition in filament dynamics between internal effects, such as self-induction and self-stretching, and external effects of background flows involving strain and rotation. Author

A92-55477

COMPUTER-AIDED DISCRIMINATION OF SLOW AND FAST TRACER PATHS

H.-H. BARTELS-LEHNHOFF, W. J. HILLER, and T. A. KOWALEWSKI (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Germany) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 4, Aug. 1992, p. 239-248. refs

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An optical method is proposed for discriminating between slow and fast tracer particles convected within a flow, which is based on the dependence of the brightness of a trace on the velocity of the corresponding tracer, whose images are captured by a CCD camera and are processed on-line. Experimental results are presented from a practical application of this method to the visualization of low-velocity streamlines in a rotating duct. The feasibility of developing this method into a quantitative tool for velocity measurements is discussed. I.S.

A92-55479

ON THE EFFECTS OF FLUID TEMPERATURE ON HOT WIRE CHARACTERISTICS. II - FOUNDATIONS OF A RATIONAL THEORY

V. VASANTA RAM (Bochum, Ruhr-Universitaet, Germany) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 4, Aug. 1992, p. 267-278. Research supported by DFG. refs

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A rational theory based on the equations for the flow past a hot wire, in conjunction with the equation for heat conduction along the wire, is developed for the effects of fluid temperature on wire characteristics. The problem is approached through two

types of rational approximation, one in terms of an overheat parameter and the other in terms of a parameter for the departure of the fluid temperature from a fixed fluid temperature. The former leads to an explicit expression for the dependence of the hot wire signal on fluid temperature and wire length. Since, in this form, it has only limited applicability to describe the characteristics of a hot wire under normal operational conditions, it is complemented by the second rational approximation. It is a combination of the two approximations that explains the salient characteristics observed when a hot wire is operated at different fluid temperatures. Based on this rational theory, a proposal is made to correct for the effects of fluid temperature on the hot wire. Author

A92-56123

SPIN-UP IN A SEMICIRCULAR CYLINDER

H. I. ANDERSSON (Norwegian Institute of Technology, Trondheim, Norway), J. T. BILLDAL (SINTEF Fluid Machinery, Trondheim, Norway), and G. J. F. VAN HEIJST (Eindhoven University of Technology, Netherlands) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 15, no. 5, Sept. 15, 1992, p. 503-524. refs

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The spin-up from rest of a free-surface fluid in a cylindrical container of semicircular cross section is investigated using a time-dependent 3D numerical simulation. The numerical simulation provides information about the secondary meridional flow, the bottom Eckman layer, and the changing spatial velocity distribution of the flow field. The numerical results are found to be in good agreement with laboratory observations. V.L.

A92-56124

AN ILU PRECONDITIONER WITH COUPLED NODE FILL-IN FOR ITERATIVE SOLUTION OF THE MIXED FINITE ELEMENT FORMULATION OF THE 2D AND 3D NAVIER-STOKES EQUATIONS

O. DAHL and S. O. WILLE (Oslo, University, Blindern, Norway) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 15, no. 5, Sept. 15, 1992, p. 525-544. Research supported by Norwegian Research Council for Fisheries. refs

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A new incomplete LU preconditioner with slight fill-in for Navier-Stokes equation is proposed which permits fill-in at certain predefined locations in the pressure coefficient matrix, rather than allowing fill-in when the size of the fill-in coefficient exceeds a certain limit. Since the locations of the fill-in are predefined, the housekeeping during the factorization process is considerably reduced. The predefined locations in the pressure matrix correspond to those locations where the corner nodes are coupled. The corner nodes are coupled if they belong to the same finite element. V.L.

A92-56125

ALPHA-GMRES - A NEW PARALLELIZABLE ITERATIVE SOLVER FOR LARGE SPARSE NON-SYMMETRIC LINEAR SYSTEMS ARISING FROM CFD

X. XU, N. QIN, and B. E. RICHARDS (Glasgow, University, United Kingdom) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 15, no. 5, Sept. 15, 1992, p. 613-623. Research supported by University of Glasgow. refs

(Contract SERC-GR/E/89056)

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Linearization of the nonlinear systems arising from fully implicit schemes in computational fluid dynamics often result in a large sparse non-symmetric linear system. Practical experience shows that these linear systems are ill-conditioned if a higher than first-order spatial discretization scheme is used. To solve these linear systems, an efficient multilevel iterative method, the alpha-GMRES method, is proposed which incorporates a diagonal preconditioning with a damping factor alpha so that a balanced fast convergence of the inner GMRES iteration and the outer damping loop can be achieved. With this simple and efficient preconditioning and damping of the matrix, the resulting method

can be effectively parallelized. The parallelization maintains the effectiveness of the original scheme due to the algorithm equivalence of the sequential and the parallel versions. Author

A92-57449

THE INITIAL BOUNDARY-LAYER FLOW PAST A TRANSLATING AND SPINNING ROTATIONAL SYMMETRIC BODY

MEHMET C. ECE (Trakya University, Edirne, Turkey) *Journal of Engineering Mathematics* (ISSN 0022-0833), vol. 26, no. 3, Aug. 1992, p. 415-428. refs
Copyright

The unsteady boundary-layer flow past an impulsively started translating and spinning rotational symmetric body of the general shape is investigated analytically. The initial stages of the phenomenon are analyzed by expanding the stream function and the swirl velocity in series in powers of time. The effects of the body shape and the rotation rate are determined. Leading and first-order solutions are obtained analytically, and second-order solutions are obtained numerically. As an example, a translating and spinning sphere is considered, and it is shown that rotation reduces the friction drag and facilitates flow separation. V.L.

N92-10163# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

NUMERICAL SIMULATION OF VORTEX BREAKDOWN BY SOLVING THE EULER EQUATIONS FOR AN INCOMPRESSIBLE FLUID

T. H. LE (Centre d'Essais Aeronautique Toulouse (France).), P. MEGE (Centre d'Essais Aeronautique Toulouse (France).), and Y. MORCHOISNE (Paris VI Univ., France) *In its Numerical Simulation of Vortex Breakdown* p 32-46 Jun. 1990 In FRENCH; ENGLISH summary Sponsored by Direction des Recherches, Etudes et Techniques
Avail: CASI HC A03/MF A01

A method of calculating unsteady, three dimensional flows of inviscid incompressible fluid was used in research on vortex breakdown. This method is based on the solution of the unsteady Euler equations in a velocity-pressure formulation, discretized by centered finite difference schemes, accurate to the second order. The application dealt with relates to a single vortex that has an initial velocity profile resembling delta wing vortices. Comparisons are made with experimental data and with other simulation methods. ESA

N92-10164# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

NUMERICAL SIMULATION OF VORTEX BREAKDOWN VIA 3-D EULER EQUATIONS

T. H. LE (Centre d'Essais Aeronautique Toulouse (France).), P. MEGE (Centre d'Essais Aeronautique Toulouse (France).), and Y. MORCHOISNE (Paris VI Univ., France) *In its Numerical Simulation of Vortex Breakdown* p 47-69 Jun. 1990 Presented at Turbulence 89, Grenoble, France, 18-21 Sep. 1989
Avail: CASI HC A03/MF A01

The long term goal is the modeling of vortex breakdown that occurs in some aerodynamic configurations at high angle of attack, (i.e., fighters with highly swept delta wings or missiles). A numerical simulation was made based on solving the 3-D Euler equations for an unsteady incompressible flow. Preliminary results were obtained using a pressure-velocity formulation with periodic boundary conditions, the Euler equations being discretized by 2nd order finite difference schemes. The continuation to this work by implementing more realistic boundary conditions and 4th order finite difference discretization schemes are presented. ESA

N92-11288# Association Aeronautique et Astronautique de France, Paris.

PRELIMINARY STUDIES FOR AUTOMIZING THERMAL FLUX MEASUREMENT EXAMINATION BY THERMOSENSITIVE COLORING [ETUDES PRELIMINAIRES POUR L'AUTOMATISATION DU DEPOUILLEMENT DES MESURES DE FLUX THERMIQUES PAR PEINTURE THERMOSENSIBLE]

M. GIRARD, J. C. BOHL, and P. BAUMANN (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) 1989 29 p In FRENCH Presented at the 26th Colloque d'Aerodynamique Appliquee, Toulouse, France, 23-25 Oct. 1990 Previously announced in IAA as A90-22439

(ISSN 0243-0177)
(AAAF-NT-89-28; ISBN-2-7170-0961-2; ETN-91-99969) Avail: CASI HC A03/MF A01; CEDOCAR, Section des Diffusions, 26 Blvd Victor, 75996 Paris Armees, France, HC 30 francs

The automatization of thermal wall flow data analysis measurement by thermosensitive coloring in gust wind tunnel is addressed. The study was directed towards more sophisticated imaging techniques based on the use of video cameras. The extraction of shade change lines was examined. Satisfactory results were obtained with an optical filter relating to software including mathematical morphology ideas. The digitization and image processing technologies likely to be applied to Thermocolor test examinations are reviewed. A simple and evolutive solution would be to digitize then process silver films currently in use. ESA

N92-11306# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerothermodynamique.

SECONDARY INSTABILITY OF THE THREE DIMENSIONAL LAMINAR BOUNDARY LAYER IN INCOMPRESSIBLE FLOW: DESCRIPTION OF THE CALCULATION CODE [INSTABILITE SECONDAIRE DE LA COUCHE LIMITE LAMINAIRE TRIDIMENSIONNELLE EN ECOULEMENT INCOMPRESSIBLE: DESCRIPTION DU CODE DE CALCUL]

G. CASALIS Apr. 1991 73 p In FRENCH
(CERT-RT-63/5618-54; ETN-91-90079) Avail: CASI HC A04/MF A01

A calculation code for resolving stability equations of the three dimensional laminar boundary layer in incompressible flow is presented. Secondary instability and the Floquet theorem are addressed. The code is based on a spectral Galerkin type method using Chebyshev polynomials. The theory is explained and as detailed use as possible of the code is shown. ESA

N92-11307# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerodynamique.

RESOLUTION OF THE NAVIER-STOKES EQUATIONS APPLIED TO THE COMPUTATION OF THE LAMINAR FLOW AROUND A TWO DIMENSIONAL WING PROFILE [RESOLUTION DES EQUATIONS DE NAVIER-STOKES APPLIQUEE AU CALCUL DE L'ECOULEMENT LAMINAIRE AUTOUR D'UN PROFIL D'AILE BIDIMENSIONNEL]

X. DESAINT-VICTOR Dec. 1990 48 p In FRENCH
(CERT-RT-65/5604-35; ETN-91-90080) Avail: CASI HC A03/MF A01

A two dimensional Navier-Stokes equation computation code of the laminar flow around a wing profile is presented. The equations are discretized by finite volume method. The motion quantity equations are resolved by an alternate direction method and the pressure correction equation by the conjugate gradient method with preconditioning. Results of calculations on a NACA0012 and an AS239 profile at different incidences are presented. A comparison with a boundary layer computation code is carried out. ESA

N92-11308# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique.

HYDRODYNAMIC TUNNEL STUDY OF THE MARGINAL VORTEX BREAKDOWN IN THE PRESSURE FIELD OF A WING PROFILE Final Summary Report [ETUDE AU TUNNEL HYDRODYNAMIQUE DE L'ECLATEMENT D'UN TOURBILLON MARGINAL DANS LE CAMP DE PRESSION D'UN PROFIL D'AILE. RAPPORT DE SYNTHESE FINAL]

J. L. SOLIGNAC and M. GALLON Nov. 1990 26 p In FRENCH
(Contract DRET-89-34-001)
(ONERA-RSF-44/1147-AY-144A; ETN-91-90084) Avail: CASI HC A03/MF A01

Tests carried out in a hydrodynamic tunnel with a view to revealing the susceptible breakdown at the time of the passage of a marginal vortex of an elliptic wind in proximity to the flight edge of an even profile are reported. Laser velocimetry measurements can precise the qualitative aspect of visualizations and conclude the absence of breakdown in real conditions of tests carried out at very low Reynolds number. ESA

N92-11310# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique. **RESOLUTION OF NAVIER-STOKES EQUATIONS AROUND PROFILES: DRAG EVOLUTION [RESOLUTION DES EQUATIONS DE NAVIER-STOKES AUTOUR DE PROFILS: EVALUATION DE LA TRAINEE. RAPPORT TECHNIQUE DE SYNTHESE]**

F. MONTIGNY-RANNOU and J. P. VEUILLOT Sep. 1990 51 p In FRENCH
(Contract DRET-89-34-001)
(ONERA-RTS-86/1685-AY-156A; ETN-91-90086) Avail: CASI HC A04/MF A01

Modifications on the two dimensional Navier-Stokes equations resolution code are presented. A numerical viscosity model was introduced which allowed more difficult cases than before to be addressed. The drag around supercritical profiles is evaluated transonically and at low speeds. A comparison with experimental results is presented. Difficulties encountered are outlined and paths to explore are described. ESA

N92-12203 Oxford Univ. (England). **HEAT TRANSFER AND INSTRUMENTATION STUDIES ON ROTATING TURBINE BLADES IN A TRANSIENT FACILITY Ph.D. Thesis**

WILLIAM D. E. ALLAN 1990 244 p
Avail: Univ. Microfilms Order No. BRD-92608

The current demands of modern aviation have encouraged engine manufacturers to develop larger, more powerful, yet quieter and more fuel efficient gas turbine engines. This has promoted particular interest in the heat loads borne by turbines, for efficiency can be improved if turbine entry temperature is increased. Presently, ceilings for this parameter are set by the thermal properties of the blade materials and their internal cooling capabilities. It has been established that flow unsteadiness and secondary flows in the turbine passages greatly influence the heat transfer rate on turbine blades and endwall surfaces. The three-dimensionality of the rotating turbine flowfield, however, complicates the interaction of these unsteady effects and their combined role in heat transfer on turbine blades. To fulfill the need to study this complex fluid environment, a model turbine stage has been installed in the working section of the Isentropic Light Piston Tunnel at Oxford. This transient facility enables the rotor to be operated at engine representative conditions. Novel high density instrumentation has been developed for use on the turbine blade. Both the production and calibration of the thin film gauges will be explained and the theory supporting heat transfer measurement using this instrumentation is presented in this thesis. Perhaps the most important feature of this thesis lies in the extensive mean and unsteady heat transfer rates measured on the blade profile. These were determined on a total of 5 streamlines and represent a significant contribution to the total experimental data available on 3-dimensional profiles at engine representative conditions.

Dissert. Abstr.

N92-12206 Oxford Univ. (England). **BLADE SURFACE PRESSURE MEASUREMENTS ON THE ROTOR OF A MODEL TURBINE STAGE IN A TRANSIENT FLOW FACILITY Ph.D. Thesis**

ANTHONY JOHN DIETZ 1990 251 p
Avail: Univ. Microfilms Order No. BRD-92632

Detailed measurements of the flow through the high pressure stage of a gas turbine engine are required to further the understanding of this complex flow field. A study of the turbine blade surface pressures is reported. Measurements were made of the time averaged and unsteady pressures in a model turbine

stage. A blade instrumentation technique was used to make the pressure measurement. Detailed performance testing and calibration of the instrumentation are presented. The surface pressure measurements were made about the midheight streamline of the rotor blade. The time averaged measurements were presented in the form of a blade isentropic Mach number distribution. The results were compared with previous studies of 2-D linear cascades with the same blade profile. Analysis of the unsteady pressure fluctuations included phase locked averages and cross correlations of the data. The effects of wake passing and shock wave passing on the blade surface pressures were detected. The results were compared with previous theoretical analysis and experimental studies of these effects.

Dissert. Abstr.

N92-12210# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerothermodynamique.

BOUNDARY LAYER TRANSITION Final Report [TRANSITION DE LA COUCHE LIMITE. RAPPORT FINAL]

F. LABURTHE and D. ARNAL Jan. 1991 43 p In FRENCH
(Contract DRET-89-002-00-40)
(CERT-RTS-55/5018-45; ETN-91-90077) Avail: CASI HC A03/MF A01

The linearized theory of laminar instability is used to analyze the properties of boundary layer stabilities developing on angled cylinders placed in supersonic flow. The calculations correspond to two series of experiments: one carried out in the R3 wind tunnel (Mach number 10) and the other in the quiet tunnel (Mach Number 3.5). The stability of the separating line, wall temperature effect, streak development, and problems related to instability modeling were specifically studied. ESA

N92-12211# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerothermodynamique.

TURBULENCE CONTROL BY INTAKE Final Report [CONTROLE DE LA TURBULENCE PAR ASPIRATION. RAPPORT FINAL]

G. PAILHAS Jan. 1991 41 p In FRENCH
(Contract STPA-85-95-009-66)
(CERT-RF-67/5004-37; ETN-91-90078) Avail: CASI HC A03/MF A01

Results from the first part of an experimental study aimed at establishing the effects of a local intake by slots on a turbulent boundary layer are reported. Measurements were taken on the wall of a test vein of an Eiffel type wind tunnel. Results show that a local wall intake leads to a significant decrease of deflection type fluctuations of longitudinal velocity in the internal region of the boundary layer region where the turbulent production is maximum. ESA

N92-12215# Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).

STUDY OF A TECHNIQUE OF LOW LEVEL TURBULENCE DETECTION Final Report [ETUDE D'UNE TECHNIQUE DE DETECTION DE BAS NIVEAUX DE TURBULENCE. RAPPORT FINAL]

R. LEBLANC (Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).), V. MERCIER (Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).), M. RIETHMULLER (Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).), and R. DECUYPERE (Ecole Royale Militaire, Brussels, Belgium) Sep. 1990 40 p In FRENCH
(Contract DRET-87-1187)
(ETN-91-90107) Avail: CASI HC A03/MF A01

A laser velocimetry technique developed to measure low level turbulence is described. The ultimate objective of the research is to detect the surface layer limit on a model in a transonic air flow. The use of laser velocimetry in the study of turbulence should allow turbulence of a few thousands in size to be detected. The detectors used in the study prove to be too large to detect the minute transition in the surface limit layer which is very thin for

the Reynolds numbers considered. The excellent potential of the method for measuring low level turbulence is however stressed.

ESA

N92-12216# Institut de Mecanique des Fluides de Lille (France).

STUDY OF DETACHED TURBULENT FLOW IN AN AIR INTAKE BY MEANS OF HIGH SPEED TOMOGRAPHY AND LASER VELOCIMETRY [ETUDE DE L'ECOULEMENT TURBULENT DECOLLE DANS UNE PRISE D'AIR EN INCIDENCE PAR TOMOGRAPHIE ULTRA-RAPIDE ET PAR VELOCIMETRIE LASER]

M. STANISLAS, T. LADEN, and J. C. MONNIER 20 Dec. 1990 33 p In FRENCH

(Contract DRET-86-003)

(REPT-90/55; ETN-91-90108) Avail: CASI HC A03/MF A01

The internal flow in the air intake of high speed aircraft is studied. Air flow at high speed tends to become detached from the sides of the intake leading to important perturbations in furnishing enough air to the engine and in maintaining constant compressor performance. The output coefficients of the intake are studied in order to better understand the internal flow. Laser velocimetry is used to better understand the internal flow. The dimensions of the intake inlet on the model are measured in order to be able to carry out mathematical modeling of the flow. ESA

N92-12219# Technische Hochschule, Darmstadt (Germany). Fachbereich Mathematik.

EXISTENCE OF THREE DIMENSIONAL, STEADY, INVISCID, INCOMPRESSIBLE FLOWS WITH NONVANISHING VORTICITY

HANS-DIETER ALBER Mar. 1991 53 p

(PREPRINT-1365; ETN-91-90187) Avail: CASI HC A04/MF A01

Steady flow of an inviscid, incompressible medium through a bounded, simply connected domain is studied. Solutions with non-vanishing vorticity are constructed for a boundary value problem. ESA

N92-14303# Newcastle-upon-Tyne Univ. (England).

EFFECT OF VISCOUS DAMPING ON THE RESPONSE OF FLOATING BODIES

M. DOWNIE (Newcastle-upon-Tyne Univ. (England).), J. GRAHAM (Imperial Coll. of Science and Technology, London, England), and X. ZHENG In NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics p 149-156 1991 Sponsored by Science Research Council

Avail: CASI HC A02/MF A10

The prediction of hydrodynamic damping due to vortex shedding on a three dimensional body in waves is discussed. A method of matching precalculated results for separated oscillatory flow past an isolated edge at each vortex shedding region of the outer potential flow field of the body in waves was extended to 3-D floating bodies by two different methods. In the first method the pressure field due to a local separated flow computed by a discrete vortex method is applied at all vortex shedding edges of the hull. In the second method, the effect of vortex shedding at an edge is represented directly in the frequency domain panel method by special edge panels. A dipole density on each of these edge panels is evaluated by making a comparison between the far field effect of the panel and the far field of the appropriate separated vortex flow modelled by the vortex method. Author

N92-14304# Istituto Nazionale di Studi Espe Architettura Navale, Rome (Italy).

A BOUNDARY INTEGRAL APPROACH IN PRIMITIVE VARIABLES FOR FREE SURFACE FLOWS

C. CASCIOLA (Imperial Coll. of Science and Technology, London (England).) and R. PIVA (Rome Univ., Italy) In NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics p 221-237 1991

Avail: CASI HC A03/MF A10

The boundary integral formulation, very efficient for free surface potential flows, was considered for its possible extension to rotational flows either inviscid or viscous. We first analyze a general

formulation for unsteady Navier-Stokes equations in primitive variables, which reduces to a representation for the Euler equations in the limiting case of Reynolds infinity. A first simplified model for rotational flows, obtained by decoupling kinematics and dynamics, reduces the integral equations to a known kinematical form whose mathematical and numerical properties have been studied. The dynamics equations to complete the model are obtained for the free surface and the wake. A simple and efficient scheme for the study of the non linear evolution of the wave system and its interaction with the body wake is presented. A steady state version for the calculation of the wave resistance is also reported. A second model was proposed for the simulation of rotational separated regions, by coupling the integral equations in velocity with an integral equation for the vorticity at the body boundary. The same procedure may be extended to include the diffusion of the vorticity in the flowfield. The vortex shedding from a cylindrical body in unsteady motion is discussed, as a first application of the model. Author

N92-14319# Royal Aerospace Establishment, Farnborough (England).

PREDICTIONS AND MEASUREMENTS OF 3D VISCOUS FLOW IN A TRANSONIC TURBINE NOZZLE GUIDE VANE ROW

G. C. HORTON, S. P. HARASGAMA, and K. S. CHANA 25 Apr. 1991 19 p Presented at the 77th AGARD PEP Symposium, San Antonio, TX, May 1991

(RAE-TM-P-1205; BR303627; ETN-92-90700; AD-A241597)

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A transonic turbine nozzle guide vane was tested in an annular cascade with two different endwall geometries. The measurements were taken at engine representative flow conditions and include surface static pressures and a down stream area traverse of total pressure. The flow through these geometries was modeled at the test conditions using a three dimensional viscous flow program. The effects of different mesh densities and two turbulence models were studied. Predictions of secondary flow and loss were obtained and are compared with the experimental measurements. The different turbulence models were found to have little effect in the predicted overall loss though there were differences in the distribution and the shape of the vane wakes. The one equation turbulence model produced wakes which had similar levels of total pressure deficit to the experiment and had a more similar shape than those with the Baldwin-Lomax algebraic model. ESA

N92-14321# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

A MULTIGRID METHOD FOR AN INVARIANT FORMULATION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN GENERAL COORDINATES

C. W. OOSTERLEE and P. WESSELING 1991 29 p

(ISSN 0922-5641)

(REPT-91-12; ETN-92-90392; PB91-218842) Copyright Avail: CASI HC A03/MF A01

Results for the two dimensional case with Dirichlet boundary conditions are presented. The equations are presented in a tensor formulation and some basic tools of tensor analysis are given together with insights into choices for computing geometric quantities and the choice of variables. A nonlinear multigrid algorithm in the structured goto-free version, the prolongation and restriction operator, and the smoother and the choice for the coarse grid operator are given. A comparison between reduction factors for a rectangular and a skewed driven capacity flow is given. The flow through an L shaped pipe with a low Reynolds number is presented and the flow through a nozzle is computed to show the accuracy of the discretization in the presence of appreciable grid irregularity. ESA

N92-14325# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

NUMERICAL EVALUATION OF AN EFFECTIVE ROE SCHEME AND CHEMICAL MODELS FOR CHEMICALLY REACTING NOZZLE FLOWS IN THERMAL EQUILIBRIUM

S. P. SPEKREIJSE and A. C. J. VENIS Jun. 1991 61 p
(LR-623; NLR-TP-90060-L; ETN-92-90414; PB92-133172) Avail:
CASI HC A04/MF A01

An efficient Roe type flux difference scheme for chemically reacting inviscid compressible flow in thermal equilibrium is presented. The numerical scheme is validated, and three well known chemical models are compared. The set of test cases concerned quasi-1-D hypersonic nozzle flows, with and without strong normal shockwaves. ESA

N92-14326# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

NUMERICAL EVALUATION OF AN EFFICIENT ROE-TYPE FLUX DIFFERENCE SCHEME FOR THERMOCHEMICAL NON-EQUILIBRIUM NOZZLE FLOWS

A. C. J. VENIS and S. P. SPEKREIJSE Jun. 1991 54 p
(LR-624; NLR-TP-90099-L; ETN-92-90415; PB92-133198) Avail:
CASI HC A04/MF A01

An efficient Roe type flux difference scheme for chemically reacting, inviscid, compressible flows in thermal nonequilibrium is presented. The numerical scheme is validated. The test cases concerned quasi-1-D hypersonic nozzle flows with and without strong normal shockwaves. ESA

N92-14328# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

NUMERICAL SIMULATION OF SPATIALLY DEVELOPING FORCED AND NATURAL MIXING LAYERS WITH LARGE EDDY SIMULATION (LES)

C. PIANESE and C. BENOCCI Apr. 1991 55 p
(VKI-TN-176; ETN-92-90457) Avail: CASI HC A04/MF A01

The spatially developing planar mixing layer solving the three dimensional incompressible Navier-Stokes equations in the primitive variables u - p (velocity vector - pressure) formulation with the large eddy simulation (LES) model of turbulence is numerically simulated. Discretization in space is achieved using a finite volume technique on a staggered grid. Different discretization schemes for the convective term were compared; laminar and subgrid stresses are discretized with centered second order accurate formulae. A second order predictor corrector Adam-Bashforth method is employed to advance the solution in time. Calculations were performed for both natural and forced mixing layers and reasonable agreement found with both experimental data and numerical simulation. The influence of the data sampling technique upon the quality of the results was also evidenced. ESA

N92-14976# Centre d'Etudes et de Recherches Anthropologie d'Appliquee, Paris (France). Aerodynamics Dept.

HYPersonic BOUNDARY LAYERS: TRANSITION AND TURBULENCE EFFECTS

D. ARNAL and B. AUPOIX In ESA, Aerothermodynamics for Space Vehicles p 25-38 Jul. 1991 Previously announced in IAA as A89-25860

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Theoretical and experimental results related to the problem of laminar turbulent transition at high speeds are surveyed. In the case of 'natural' transition, the linear stability theory can describe the development of Tollmien-Schlichting waves, of Goertler vortices (on concave walls) and of stationary vortices generated by cross flow instability (three dimensional flows). The problem of boundary layer tripping by large roughness elements is also studied in two dimensional as well as in three dimensional flows. Hypersonic turbulent boundary layers are considered. The importance of compressibility effects upon turbulence and the differences in turbulence structure between low and high speed boundary layers are discussed. Turbulence modeling problems specific to high speed flows are addressed. Some examples of hypersonic boundary layers computations are presented. ESA

N92-15026# Vrije Univ., Brussels (Belgium). Dept. of Fluid Dynamics.

A MULTIBLOCK/MULTIGRID CODE FOR THE EFFICIENT SOLUTION OF COMPLEX 3D NAVIER-STOKES FLOWS

C. HIRSCH (Vrije Univ., Brussels (Belgium).), C. LACOR (Vrije Univ., Brussels (Belgium).), A. RIZZI (Aeronautical Research Inst. of Sweden, Bromma.), P. ELIASSON (Aeronautical Research Inst. of Sweden, Bromma.), I. LINDBLAD (Aeronautical Research Inst. of Sweden, Bromma.), and J. HAEUSER (European Space Agency, European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In ESA, Aerothermodynamics for Space Vehicles p 415-420 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An integrated software package for the simulation of three dimensional Navier-Stokes flows about complex geometries is described. It integrates a grid generator with a solver and a graphical post processing system. It is easily transportable to different computer systems as it is based on standard FORTRAN77 and C++/PHIGS/X Windows for the graphics. In the present contribution, the solver is presented. Emphasis is put on the general framework used to incorporate various schemes based in central and upwind discretization, as well as on the multiblock/multigrid structure of the code and on its internal data management. The applicability of the code is illustrated with three dimensional results of the laminar Navier-Stokes flow in a corner geometry. ESA

N92-15027# Dornier System G.m.b.H., Friedrichshafen (Germany). Aerodynamics Dept.

COMPUTATIONAL AEROTHERMODYNAMIC METHODS FOR INDUSTRIAL APPLICATIONS TO RE-ENTRY AND HYPersonic CRUISE PROBLEMS

H. RIEGER, H. STOCK, and B. WAGNER In ESA, Aerothermodynamics for Space Vehicles p 421-437 Jul. 1991

Copyright Avail: CASI HC A03/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A survey of computational fluid dynamics capabilities and related methodologies which may be useful to support the design of vehicles flying at high supersonic speeds in cruise conditions or passing the hypersonic flight regime during reentry from low Earth orbit, is given. A main objective in hypersonic design is the search for the best compromise between a feasible flight control system and an aerodynamic shape exposed to thermal loads which can be tolerated by the thermal protection system. For the prediction of aerokinetic thermal loads, depending on the flow situation, several alternatives exist which can give reliable answers. Emphasis is placed on Euler and Navier-Stokes methods as well as on more limiting prediction tools like parabolized Navier-Stokes and boundary layer methods. Application of these flow simulation methods to simple as well as to complex configurations of current interest are presented. Activities in the area of transition for hypersonic flows are discussed. ESA

N92-15029# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NUMERICAL SIMULATION OF THERMOCHEMICAL NON-EQUILIBRIUM VISCOUS FLOWS AROUND REENTRY BODIES

F. COQUEL (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), V. JOLY (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), C. MARMIGNON (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), and C. FLAMENT (Ohio State Univ., Columbus.) In ESA, Aerothermodynamics for Space Vehicles p 447-452 Jul. 1991 Previously announced in IAA as A91-45648 Sponsored by Direction des Recherches, Etudes et Techniques

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A fully coupled implicit finite volume method is applied to the prediction of axisymmetric and plane equilibrium viscous flows around reentry bodies. The governing equations are discretized using a second order upwind scheme of Harten type for the inviscid fluxes and a space centered scheme for the viscous fluxes. The

effects of different physical assumptions and models are investigated. Chemical and thermochemical nonequilibrium calculations around a hyperboloid are compared. The numerical simulation of the chemical nonequilibrium flow around a double ellipse is presented. Comparisons are made respectively between two chemical models and between two transport phenomenon models. ESA

N92-15030# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

EQUILIBRIUM SOLUTION OF THE EULER AND NAVIER-STOKES EQUATIONS AROUND A DOUBLE ELLIPSOIDAL SHAPE WITH MONO- AND MULTI-BLOCKS INCLUDING REAL GAS EFFECTS, PART 1

H. WONG and J. HAEUSER *In its* Aerothermodynamics for Space Vehicles p 453-458 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Chemical and thermal equilibrium solutions of the Euler and Navier-Stokes equations around a double ellipsoidal shape at Mach 25 with an angle of attack of 30 degrees are presented. Atmospheric air is assumed to be the continuum medium and is modeled as a real gas. The solutions are obtained by using a finite volume method and the algorithm employs a cell centered fully implicit upwind scheme. Three dimensional mono and multiblock structured grids are employed in order to study the influence of grid topology on the physical solution. Moreover, the grid qualities such as orthogonality, grid point clustering, smoothness, and grid size are also discussed. In particular, the effect of grid adaptation with respect to the physical solution was examined. The aerodynamic coefficients, property contours, and shock standoff distance are presented and compared in each case. ESA

N92-15033# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

PARALLELIZATION OF A DIRECT SIMULATION MONTE CARLO (DSMC) CODE FOR FLUID DYNAMICS

GIULIO PRISCO *In its* Aerothermodynamics for Space Vehicles p 477-482 Jul. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Direct Simulation Monte Carlo (DSMC) codes are an essential tool for the computation of aerothermodynamical effects on hypersonic space vehicles. They permit computer simulation of flows to be extended in the rarefied regime, where macroscopic fluid equations do not hold. Being more CPU (Central Processing Unit) intensive than other computational approaches, DSMC codes are an ideal application for parallel machines. The work done in order to modify a DSMC code for parallel/vector execution is described. Short, but, self contained introductions to rarefied gas dynamics, Monte Carlo techniques, and parallel/vector processing are also given. ESA

N92-16226# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

COMPUTER GRAPHICS AND FLOW VISUALIZATION IN COMPUTATIONAL FLUID DYNAMICS

1991 386 p Lecture series held in Rhode-Saint-Genese, Belgium, 16-20 Sep. 1991 Original contains color illustrations (ISSN 0377-8312)
(VKI-LS-1991-07; ETN-92-90462) Copyright Avail: CASI HC A17/MF A04

The objective of this lecture series was to present the state of the art in computer graphics and scientific visualization as applied to CFD (Computational Fluid Dynamics). An introduction was given to existing tools for graphics, including basic graphical software and hardware concepts, standards for graphical primitives and user interfaces. Two lectures emphasized the use of object oriented programming applied to scientific visualization software. A software interface and visualization language was presented allowing the

user to configure or to design a field specific or even project specific environment while maintaining a core program to perform all the work of data extraction, manipulation and rendering. The status of scientific visualization of NASA's Numerical Aerodynamic Simulation facility was reviewed in some detail and some experiments on virtual environments were evaluated.

ESA

N92-16227# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. fuer Theoretische Stromungsmechanik.

THREE-DIMENSIONAL COMPUTER GRAPHICS IN FLOW VISUALIZATION

HANS-GEORG PAGENDARM *In* VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 117 p 1991 Original contains color illustrations
Copyright Avail: CASI HC A06/MF A04

Lecture notes on the software architecture of flow visualization software and flow visualization techniques in computer graphics are presented. They serve as a first approach to computer graphics and flow visualization in computational fluid dynamics. References to literature are included. The graphics included show the output of the graphic system HIGHEND. The data used as an example to demonstrate the capabilities of HIGHEND were created from a Navier-Stokes computation of the flow around the DFVLR (German Aerospace Research Establishment) F5 wing. An analysis of the size and structure of data produced in fluid mechanics calculations as well as hardware constraints of today's workstations and networks leads to particular software design and a concept of a collection of tools for processing and displaying data appears to have advantages in this kind of computing environment. A range of standard visualization techniques is combined to give an interactive workbench for data postprocessing. ESA

N92-16231# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. for Theoretical Fluid Mechanics.

THE RECOVERING OF FLOW FEATURES FROM LARGE NUMERICAL DATA BASES

HEINRICH VOLLMERS *In* VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 30 p 1991 Original contains color illustrations
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A study aimed at giving some ideas of recovering and representing flow features and encouraging the invention and introduction of new data reductions and representations is presented. An example of the turbulent transonic flow around a delta wing is illustrated and some requirements are deduced by asking what is desirable and achievable for an analysis and graphics system. The use of and necessity for several tools and kinds of representations is explained. The results presented in the figures are discussed only qualitatively. ESA

N92-16234# Technische Univ., Hanover (Germany). Inst. fuer Meteorologie und Klimatologie.

VISUALIZATION OF INSTATIONARY FLOWS BY PARTICLE TRACES Abstract Only

S. RAASCH *In* VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 1 p 1991
Copyright Avail: CASI HC A01/MF A04

An abstract on a study which represents a model of atmospheric flow output by computer movies is presented. The structure and evolution of the flow is visualized by starting weightless particles at the locations of the model grid points at distinct, equally spaced times. These particles are then only advected by the flow. In order to avoid useless accumulation of particles, they can be provided with a limited lifetime. Scalar quantities can be shown in addition to using color shaded contours as background information. A movie with several examples of atmospheric flows, for example convection in the atmospheric boundary layer, slope winds, land seabreeze and Kelvin-Helmholtz waves is presented. The simulations are performed by two dimensional and three dimensional nonhydrostatic, finite difference

models. Graphics are produced by using the UNIRAS software and the graphic output is in form of CGM metafiles. The single frames are stored on an ABKAS real time video disc and then transferred to a BETACAM-SP tape recorder. The graphic software is suitable to produce 2 dimensional pictures, for example only cross sections of three dimensional simulations can be made. To produce a movie of typically 90 seconds duration, the graphic software and the particle model need about 10 hours CPU time on a CCD CYBER 990 and the CGM metafile has a size of about 1.4 Gbyte. ESA

N92-16235# Ecole Centrale de Nantes (France).

INTERACTIVE VISUALIZATION OF CFD RESULTS ASCETE Abstract Only

YVES LECOINTE /n VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 1 p 1991
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The study of interactive visualization of Computational Fluid Dynamics (CFD) results by ASCETE (a French acronym for aid to simulation and comprehension of 3D external flows) software is presented. This software is running on Silicon Graphics Inc. (SGI) platforms and is used to show steady or unsteady results in fluid dynamics or in other domains where results are mainly scalar and vector fields. The basis of the present version is structured grids with a number of points allowed to vary with time. Some extensions are underway and concern mainly multiblock structured grids and unstructured grids. So it is possible to explore unsteady results. A graphical interface and graphic visualizations are used the GL library. The code is written in C for the interface and in FORTRAN for the visualizations. This software can be used on a multiprocessor Power station but runs on a Personal Iris. ESA

N92-16236# MCG SA, Brussels (Belgium).

VISUALIZATION OF RESULTS OF MATHEMATICAL SIMULATIONS: THE CONTRIBUTION OF MCG Abstract Only

/n VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 1 p 1991
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An abstract on the contribution of MCG to the visualization of results of mathematical simulations is presented. MCG, which is a Belgian company dealing with synthesis three dimensional animation, became aware of a need which was the result of the increasing power of the hardware and software tools used by the engineers today: the visualization of the results of mathematical simulations. The design of a program including various visualization tools adapted to software like SAMCEF in the field of system dynamics and ECRIN Principia and SDRC in the field of fluid dynamics was undertaken by MCG. In fluid dynamics, the program which associates color with the relative values of variables in scalar fields, enables the calculation of iso-value surfaces, cuts in the mesh, and in the case of vector fields, offers colored arrow representation and animated particle paths in the velocity field. The system dynamics program reads the files generated by SAMCEF and allows complex periodic or transient movements on a reactor blade simulated opening of a structure in space to be represented. ESA

N92-16237# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. for Fluid Dynamics.

MIKADO: A GRAPHIC PROGRAM

Y. SECRETAN /n VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 1 p 1991
Copyright Avail: CASI HC A01/MF A04

A discussion of the modular program Mikado is presented. Mikado was developed with the goal of creating a flexible graphic tool to display and help analyze the results of finite element fluid flow computations. Mikado works on unstructured meshes, with elements of mixed geometric type, but also offers the possibility of using structured meshes. The program can be operated by both menu and mouse (interactive), or by command file (batch). Mikado is written in FORTRAN, except for a few system dependent subroutines which are in C. It runs presently on Silicon Graphics'

workstations and could be easily ported to the IBM-RISC System/6000 family of workstations. ESA

N92-16238# Centro Italiano Ricerche Aerospaziali, Naples. Computer Graphics and CAE.

FLOVIS (FLOW VISUALIZER) USER MANUAL, RELEASE 2.6, SEPTEMBER 1990

UMBERTO BERRINO, PAOLO LEONCINI, and FRANCESCO LUCIGNANO /n VKI, Computer Graphics and Flow Visualization in Computational Fluid Dynamics 13 p 1991

Copyright Avail: CASI HC A03/MF A04

FLOVIS is a three dimensional interactive graphics postprocessor suited for computational fluid dynamics applications and in general, for scientific visualization using three dimensional structured grids. The wireframe, contour map, isocurves, vector plot, and two dimensional line chart data representations are described. Information windows, interactivity, color ramps, color scanner, animation, index sweep, input data file, command line options, main menu selections, and main menu and submenus are described. ESA

N92-17312# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

NUMERICAL GRID GENERATION USING A VARIATIONAL METHOD Thesis - Univ. der Bundeswehr Muenchen [NUMERISCHE RECHENNETZGENERIERUNG MIT EINEM VERFAHREN DER VARIATIONSRECHNUNG]

MICHAEL EULER Apr. 1991 100 p In GERMAN (MBB-FE211-S-PUB-447; ETN-92-90618) Copyright Avail: CASI HC A05/MF A02

Numerical grids were generated for the solution of partial differential equations of the thermofluid dynamics. The computational grids have to model the solid boundary, and to solve the occurring flow phenomena with sufficient accuracy. A grid generator was implemented that uses a nonlinear optimization method of the variational calculus to generate computational grids for two dimensional geometries. The solution algorithm is based on a conjugate gradient method, and was tested on several geometries. This method has advantages with a view to adaptive grid generation. ESA

N92-17974# Manchester Univ. (England). Aeronautical Engineering Group.

PHYSICAL AND COMPUTATIONAL MODELLING OF STRATIFIED SHEAR FLOWS Final Report

T. N. STEVENSON and L. Y. PAO Dec. 1989 53 p (Contract ARE-2052/70)

(AERO-REPT-8909; ETN-92-90917) Avail: CASI HC A04/MF A01

Numerical computations and correlation work in stratified research are summarized. Studies on the internal waves around bodies are presented. Computations with no free surface and with a free surface using a Marker And Cell (MAC) method are described. Solutions for the stratified flow around a horizontal cylinder of square cross section under different conditions are shown. ESA

N92-18088# Manchester Univ. (England). Aeronautical Engineering Group.

A SURVEY OF THE NUMERICAL SIMULATION OF UNSTEADY FLOWS PAST CAVITIES (WITH AERODYNAMIC APPLICATIONS)

D. R. EMERSON and D. I. A. POLL 1990 36 p (Contract MOD-2052/78/RAE(F))

(AERO-REPT-9002; ETN-92-90919) Avail: CASI HC A03/MF A01

A survey of the numerical modeling of cavity flows (with aerodynamic applications) was undertaken. All the modern methods are shown to have been able to capture the important features. In general, the agreement between simulation and experiment is qualitative although, for some L/D ratios and free stream Mach numbers, good quantitative agreement has been achieved. When discrete frequencies are present, the predicted sound pressure

levels typically lie within 2 to 10 dB of the experimental values. The higher harmonics are generally smoothed out due to the necessary presence of artificial viscosity to stabilize the computational scheme. The most popular numerical method is found to be that suggested by MacCormack. ESA

N92-18221# National Aerospace Lab., Amsterdam (Netherlands). Fluids Div.

CAR 88: A METHOD TO CALCULATE SUBSONIC AND SUPERSONIC, STEADY AND UNSTEADY, POTENTIAL FLOW ABOUT COMPLEX CONFIGURATIONS

M. H. L. HOUNJET 7 Oct. 1988 75 p Sponsored in part by Royal Netherlands Air Force (NLR-TR-88154-U; ETN-92-90956; AD-B159336L) Avail: CASI HC A04/MF A01

A description of the method CAR88 for the calculation of steady and time linearized unsteady subsonic and supersonic flow about complex two dimensional and three dimensional configurations is given. The method belongs to the category of the so called panel methods. Results of applications in supersonic flow made to a two dimensional oscillating flat plate, a two dimensional double and single edge airfoil, three dimensional cones, and to single and multiple interfering wing surface are shown. ESA

N92-18235# Manchester Univ. (England). Aeronautical Engineering Group.

COMPUTATION OF LAMINAR FLOW OVER CAVITIES Ph.D.

Thesis Final Report

D. R. EMERSON and D. I. A. POLL 1990 296 p (Contract MOD-2052/78/RAE(F)) (AERO-REPT-9013; ETN-92-90929) Avail: CASI HC A13/MF A03

A survey of the numerical simulation of cavity flows with aerodynamic applications is presented. Based on this information, a MacCormack TVD scheme was developed to solve the Navier-Stokes equations for laminar flow. The computations indicate that the oscillatory frequencies are essentially independent of wall temperature $T(\text{sub } W)$, stagnation temperature $T(\text{sub } 0)$, boundary layer thickness at separation $\delta(\text{sub } s)$ and unit Reynolds number. However, the magnitude of the pressure fluctuations depends strongly on $T(\text{sub } w)$ and $\delta(\text{sub } s)$. High wall to edge temperature ratios produce a damping of the oscillations, with a corresponding decrease in drag. For supersonic flow below Mach 2, a fundamental frequency is produced which is consistent with the predictions of existing semiempirical methods, and which corresponds to a second mode of oscillation. Higher frequencies are found and these are harmonics of the fundamental frequency. For Mach numbers between 2 and 2.5, subharmonics are also present. At Mach 2.5, a first mode occurs which is also consistent with semiempirical methods. Higher frequencies also occur but they are not harmonics. The computations also indicate that thick boundary layers will damp the oscillations and reduce drag. ESA

N92-18236# Manchester Univ. (England). Aeronautical Engineering Group.

THE LAMINAR NATURAL CONVECTION ON A HORIZONTAL SURFACE M.S. Thesis

YVONNE OWEN Oct. 1990 30 p Sponsored by Science Research Council (AERO-REPT-9015; ETN-92-90930) Avail: CASI HC A03/MF A01

Laminar natural convection flows which develop from a circular cut out on a heated horizontal surface of an infinite expanse are discussed. The first order boundary layer analysis includes variable properties effects and is studied in detail for both air and water flows. The boundary layer development which forms both close to the circular cut out, and at a long distance from this leading edge are studied throughly. Detailed calculations and results are presented for both cases. The equivalent boundary layer problem of the given surface cooled and facing downwards were also studied. Results in this case are given for water flow. ESA

N92-18244# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany).

INSTITUTE FOR EXPERIMENTAL FLUID MECHANICS: RESULTS FOR 1990 [INSTITUT FUER EXPERIMENTELLE STROEMUNGSMECHANIK ERGEBNISSE 1990]

T. GREEN-THOMAS Jul. 1991 152 p In GERMAN (IB-222-90-A-46) Avail: CASI HC A08/MF A02

Summaries are presented for areas of research at the Institute. The departments represented include the Dept. of Measurement Physics, Dept. of Boundary Layer and Subsonic Flow, Dept. of Lattice Flow, Dept. of High Speed Flow, and the Dept. of Rarefied and Real Gas Flow. Some of the programs are as follows: commercial aircraft technologies; military aircraft and aircraft structures technology; turbine aircraft engine technologies; simulations and design fundamentals; hypersonic and reentry technologies; and orbital technologies. E.R.

N92-18291# Manchester Univ. (England). Aeronautical Engineering Group.

THE FLOW PAST BLUFF BODIES BY A VORTEX METHOD

Ph.D. Thesis

ANDREW P. BURROWS 1990 132 p Sponsored by Science Research Council (AERO-REPT-9016; ETN-92-90931) Avail: CASI HC A07/MF A02

A review of the literature on vortex methods for the representation of vortex sheets and the literature in two dimensional viscous incompressible flow past bluff bodies, mainly the circular cylinder, both experimental and numerical, with emphasis on the use of vortex methods, is presented. An algorithm for the transport of vorticity in two dimensional incompressible flow past a circular cylinder is considered. The algorithm considered only Reynolds numbers (Re) 20, 40, 100 and 200. The physical predictions of this approach for uniform flow past a circular cylinder over a wider range of Re , and to mathematically develop and apply the algorithm to other flows and bodies, are further investigated. The working Re of the method is extended up to 1000, and down to 2. Steady symmetric fully developed flow is studied for Re between 2 and 500, and the symmetric starting flow is examined for Re greater than or equal to 100 and less than or equal to 500. A rotating cylinder is considered next for Re greater than or equal to 5 and less than or equal to 200. The algorithm is developed for a noncircular body, and the flow past an elliptic cylinder at incidence is studied for Re greater than or equal to 15 and less than or equal to 200. The results from the above works are compared, where possible, with the available literature. This study led to the development of a versatile algorithm for two dimensional bluff body flows which can be adapted for application to arbitrary body shapes and used to calculate aerodynamic forces, Strouhal numbers, and vorticity distributions in the flow field and to the discovery of various interesting physical phenomena. ESA

N92-18317# Manchester Univ. (England). Aeronautical Engineering Group.

PROPAGATION OF SHOCK WAVES THROUGH CLOUDS Ph.D. Thesis

XIN XIN ZHOU Oct. 1990 150 p (AERO-REPT-9104; ETN-92-90935) Avail: CASI HC A07/MF A02

The behavior of a shock wave propagating into a cloud consisting of an inert gas, water vapor and water droplets was investigated. This has particular application to sonic bangs propagating in the atmosphere. The finite difference method of MacCormack is extended to solve the one and two dimensional, two phase flow problems in which mass, momentum and energy transfers are included. The FCT (Fluid Corrected Transport) technique developed by Boris and Book was used in the basic numerical scheme as a powerful corrective procedure. The results for the transmitted shock waves propagating in a one dimensional, semi infinite cloud obtained by the finite difference approach are in good agreement with previous results by Kao using the method characteristics. The advantage of the finite difference method is its adaptability to two and three dimensional problems. Shock wave

propagation through a finite cloud and into an expansion with a 90 degree corner was investigated. It was found that the transfer processes between the two phases in two dimensional flow are much more complicated than in the one dimensional flow cases. This is mainly due to the vortex and expansion wave generated at the corner. In the case considered, further complications were generated by the reflected shock wave from the floor. Good agreement with experiment was found for one phase flow but experimental data for the two phase case is not yet available to validate the two phase calculations. ESA

N92-18319# Manchester Univ. (England). Aeronautical Engineering Group.
ON THE APPROXIMATE REPRESENTATION OF VELOCITY AND SHEAR STRESS DISTRIBUTIONS IN LOW-SPEED BOUNDARY LAYERS Ph.D. Thesis Final Report
 PHILIP CARTER and D. I. A. POLL 1990 167 p
 (Contract MOD-2052/77/RAE(F))
 (AERO-REPT-9012; ETN-92-90938) Avail: CASI HC A08/MF A02

A method for the representation of mean shear stress and velocity profiles in low speed, laminar and turbulent boundary layers is described. It has a unique advantage over existing techniques in that the distributions of velocity and stress may be related by any turbulence model. This makes the profiles particularly useful as starting solutions for complex flow calculations. Two methods for obtaining the mean shear stress distribution are proposed. The first uses a near wall solution of the x momentum equation and an 'intermittency' or 'smoothing' function. The alternative approach represents the shear stress distribution using a power series with suitable boundary conditions specified at the wall and at the edge of the boundary layer. In both cases the velocity profiles are obtained by integrating the shear stress profiles using a turbulence model or by setting the turbulent Reynolds stresses to zero in the case of laminar flow. Velocity profiles, shear stress profiles and integral properties obtained from the technique are compared with experimental data and predictions from the Cebeci-Smith full field method. Predictions for laminar flow profiles are compared with the Falkner-Skan solutions. ESA

N92-18320# Manchester Univ. (England). Aeronautical Engineering Group.
NUMERICAL SOLUTIONS FOR UNIFORM FLOW AROUND SYMMETRICAL BODIES USING PANEL METHODS M.S. Thesis
 IAD ANTON FARAH Oct. 1990 35 p
 (AERO-REPT-9014; ETN-92-90939) Avail: CASI HC A03/MF A01

The convergence properties of two dimensional panel methods were recently studied to determine the effect on rates of convergence of singularity strength variation along a panel and panel curvature. The panel methods were applied to several simple benchmark test cases for which analytical results were available for singularity distribution as well as velocity distribution on the body. This work was limited to source sink panels. The results are reviewed and the approach is extended to study vortex panels. ESA

N92-18323# National Aerospace Lab., Amsterdam (Netherlands). Informatics/Aerodynamics Div.
VISIAN: A VISCOUS-INVISCID STRONG-INTERACTION ANALYSIS SYSTEM
 A. E. P. VELDMAN, J. P. F. LINDHOUT, and E. DEBOER 16 May 1988 98 p
 (Contract NIVR-01901-N)
 (NLR-TR-88081-U; ETN-92-90952) Avail: CASI HC A05/MF A02

A description of VISIAN, a simulation method for two dimensional viscous flows with strong viscous inviscid interaction is given. The mathematical model and the numerical algorithm are presented. VISIAN was coupled with the inviscid flow solver TRAFS. Results for a number of airfoils are shown and a comparison with results from other computations and with experiments is made. ESA

N92-18933# Imperial Coll. of Science and Technology, London (England).

THE 8TH SYMPOSIUM ON TURBULENT SHEAR FLOWS.

VOLUME 1: SESSIONS 1-18

Sep. 1991 522 p Symposium held in Munich, Fed. Republic of Germany, 9-11 Sep. 1991
 (Contract DAJA45-91-M-0079)

(AD-A243809; R/D-6662-AN-02) Avail: CASI HC A22/MF A04

Session topics in this volume include wall flow, mixing layers, free shear flow, two phase flow, aerodynamic flow, unsteady flow, atmospheric flow, applications, separated flow, transition, homogenous flow, and transition and control. GRA

N92-18934# Imperial Coll. of Science and Technology, London (England).

THE 8TH SYMPOSIUM ON TURBULENT SHEAR FLOWS:

VOLUME 2: 19-31, POSTER SESSIONS.

Sep. 1991 485 p Symposium held in Munich, Fed. Republic of Germany, 9-11 Sep. 1991

(Contract DAJA45-91-M-0079)

(AD-A243810; R/D-6662-AN-01) Avail: CASI HC A21/MF A04

Session topics in this volume include large eddy simulations, separated flows, compressible flows, combustion, buoyant flows and heat transfer, complex free flow, closures, coherent structures, rotation, and curvature effects. GRA

N92-19294# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes de Recherches en Aerothermodynamique.

A DEFICIT APPROACH TO THREE DIMENSIONAL INCOMPRESSIBLE FLOWS Final Report [APPROCHE DEFICITAIRE POUR ECOULEMENTS TRIDIMENSIONNELS INCOMPRESSIBLES. RAPPORT FINAL]

B. AUPOIX and O. ROUZAUD Apr. 1991 32 p In FRENCH
 (Contract DRET-89-002-057)

(CERT-RF-39/5025-36; ETN-92-90870) Avail: CASI HC A03/MF A01

A deficit approach originally developed for hypersonic laminar limit layers in two dimensional flows is extended to three dimensional incompressible flows and laminar and turbulent flows. The extension of the approach is straightforward for laminar flow, but requires a totally different approach for turbulent flow. Modifications carried out to the approach in order to handle turbulent flows are outlined. The deficit equations are included in a three dimensional boundary layer calculation program. Results from previous two dimensional flow studies validate the inclusion of these equations in the calculation program. ESA

N92-19349# Metraflu, Ecully (France).

INHOMOGENEOUS TURBULENCE BEYOND SPECTRAL EQUILIBRIA: AERONAUTICAL APPLICATIONS Final Report [TURBULENCE NON-HOMOGENE HORS D'EQUILIBRE SPECTRAL: APPLICATIONS AERONAUTIQUES. RAPPORT FINAL]

JEAN-PIERRE BERTOGLIO and MARC MICHARD Dec. 1990 93 p In FRENCH

(Contract DRET-88-351)

(ETN-92-90867) Avail: CASI HC A05/MF A01

A spectral model of inhomogeneous turbulence is proposed. The simplified model is based on closure at two homogeneous points. The terms of inhomogeneous transport are expressed by means of a model based on one point of closure. The model is included in a finite element calculation code. Applications of the method to enclosed flow in aeronautical situations are proposed. Direct numerical simulation is carried out as a means of validating the method. The feasibility of a reference experiment is considered. Initial application to aeronautic calculations is performed. ESA

N92-19916# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics and Fluid Dynamics.

SOME ASPECTS OF SHOCK CAPTURING METHODS FOR GAS DYNAMICS

E. F. TORO Aug. 1991 55 p Presented at the Computational

Fluid Dynamics Workshop, Sendai, Japan, Jul. 1991
(CRANFIELD-AERO-9112; ISBN-1-871564-32-8; ETN-92-90755)
Coll. of Aeronautics, Cranfield, Bedford, MK43 0AL, England, HC
8 sterling pounds

Three topics on modern shock capturing methods for the time dependent Euler equations of gas dynamics are addressed. The Weighted Average Flux (WAF) Method, one of the several Riemann problem based shock capturing methods, is presented. The Riemann problem is addressed. An efficient exact Riemann solver, a robust noniterative Riemann solver based on the behavior of the exact solver, and an improved version of the Harten-Lax-van Leer Riemann solver are presented. A very simple linearized Riemann solver is presented together with a Riemann solver adaptation procedure. A Riemann solver adaptation procedure that has proved successful is presented. Applications of the WAF method with the various Riemann solvers are presented. ESA

N92-19932# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

FUNDAMENTAL STUDY OF SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION WITH PASSIVE CONTROL IN TRANSONIC FLOW Ph.D. Thesis - Paris Univ. VI
REYNALD BUR 1991 238 p In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-1278)
(ISSN 0078-3781)
(ONERA-NT-1991-9; ETN-92-90754) Avail: CASI HC A11/MF A03

Different techniques used to control the interaction between a shock wave and a turbulent boundary layer show that passive control tends to improve profile performance at transonic velocities. An analysis of an interaction subjected to passive control was performed in a transonic channel, taking into account the following parameters: shock location with respect to the cavity, porosity, hole diameter of the perforated plate, and cavity depth. The flow was qualified by means of schlieren visualizations, wall pressure measurements, and probing with a two dimensional laser velocimetry system. A momentum balance realized in the control region was allowed to select configurations where frictional drag was reduced compared to the reference case without control. The theoretical study is based on a boundary layer type approach using the first order Prandtl equations. The turbulent field was computed considering equilibrium and nonequilibrium models. Passive control influences take place both in the mean field through the existence of transpiration velocity giving a boundary layer condition not equal to zero at the porous wall and in the turbulent field. This effect is represented by introduction of a modified Van Driest damping function. Solutions to these modifications are proposed. A comparison with experimental results, gives information about the validity of turbulence models and modifications which consider an effect of control. ESA

N92-20180# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).

STOCHASTIC PERTURBED SYSTEMS: THEORY AND PRACTICE OF KARMAN VORTEX STREETS Thesis [UEBER STOCHASTISCH GESTOERTE SYSTEME: THEORIE UND ANWENDUNG AUF DIE KARMANSCHEN WIRBELSTRASSEN]
JOERG HOLTFOOT May 1991 77 p In GERMAN; ENGLISH summary Sponsored by DFG
(ISSN 0436-1199)
(MPIS-4/1991; ETN-92-91014) Avail: CASI HC A05/MF A01

In the theory of randomly perturbed dynamical systems developed by Friedlin and Wentzell, the potential of a vectorfield is generalized to the so called quasipotential. For general nonlinear systems, the quasipotential turns out to be nondifferentiable along certain lines. These lines are investigated numerically for bistable systems with at least one limit cycle. It is found that even for strong nonlinearity, the quasipotential remains smooth in a finite neighborhood of the stable limit cycle. This formalism is used for the reconstruction of dynamical systems for measured time series. The method is successfully applied to velocity measurements in a Karman vortex street at Reynolds numbers 60 to 150. ESA

N92-20230# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).

FORMATION AND STABILITY OF A SEMI-INFINITE VORTICITY LINE UNDER AN ADHERENCE CONDITION Final Report [FORMATION ET STABILITE D'UNE LIGNE SEMI-INFINIE DE VORTICITE SOUMISE A UNE CONDITION D'ADHERENCE. RAPPORT FINAL]

MICHELE LARCHEVEQUE 1991 13 p In FRENCH
(Contract DRET-88-1215)
(ETN-92-91075) Avail: CASI HC A03/MF A01

Formation and stability of vortices, whose lifetime is long in face of their rotation characteristic, are addressed. The adherence condition, to a wall orthogonal to the vortex axis, imposed by the flow is studied specifically. A mathematical model of the vortex origin is proposed which applies not only to meteorological tornado phenomena, but to hydrodynamics, in the draining of basins, and magnetohydrodynamics, in terms of plasma confinement. ESA

N92-20232# Institut National des Sciences Appliquees, Rouen (France).

MARCO CONTRACT REPORT [RAPPORT DE CONTRAT MARCO]

YANN LEBRET and DANY VANDROMME 1991 110 p In FRENCH
(Contract DRET-89-216)
(ETN-92-91077) Avail: CASI HC A06/MF A02

Numerical flow computation in the mixing layer is addressed. The physical process is described and a resolution algorithm for the Navier-Stokes equations, using a second order explicit-implicit predictor-corrector MacCormack scheme, is given. Turbulence models which were previously developed are reviewed. Results and conclusions are given. ESA

N92-20317 Bath Univ. (England).

EXPERIMENTAL AND ANALYTICAL STUDIES OF JETS IN QUIESCENT OR ROTATING FLOW FIELDS Ph.D. Thesis
X. P. GAN 1990 384 p

Avail: Univ. Microfilms Order No. BRDX93713

A technique of analyzing two-dimensional flow by thermal anemometry measurements was developed. It is capable of deriving the information of instantaneous velocity, mean velocity, and turbulence intensity. However, this technique suffers from the inability to discriminate the velocity direction; hence, there is some inaccuracy in both mean velocity and turbulence intensity in the case of low velocity or for the measurement of a small velocity component. To improve the data analysis technique, it was necessary to combine it with the detection of velocity direction. Measurements were performed in a hydraulic analog rig to simulate the fuel injection process in a direct injection diesel engine, using the hot film anemometry technique and the two-dimensional data analysis method developed. Both steady state and transient injection were studied. In each case, the injection process is studied with the jet subjected to a different degree of deflection. The velocity decay along the jet centerline of the undeflected jet was compared with the centerline velocity decay of open jets. The decay of a deflected jet along its axis is more difficult to describe because of a lack of knowledge about the exact location of the jet axis or the jet centerline. This difficulty becomes more considerable for the transient jet. Discussion was concentrated on the mean velocity components and the turbulent fluctuation within the jet envelope and in the vicinity of jet shear layer boundary. Turbulence intensity distribution is affected by two factors: the relative velocity between the jet and the surrounding fluid; and the interference between the jet and the swirl. A symmetric distribution of both mean velocity and the turbulence intensity is observed for the undeflected jet. However, with swirl present, the symmetry was destroyed; the resulting jet has a thin outer boundary and a thick inner boundary. Dissert. Abstr.

N92-21232# Duisburg Univ. (Germany).

BOUNDARY LAYER FLOW IN AXIAL COMPRESSORS (THEORETICAL PART) Interim Report No. 1, Jan. 1985 - Sep. 1985 [RANDZONENSTROMUNG IN AXIALVERDICHTERN (THEORETISCHER TEIL). 1: ZWISCHENBERICHT, JAN. 1985 - SEP. 1985]

H.-J. DOHMEN 1985 69 p In GERMAN
(Contract T/RF42/E0013/E1413)
(ETN-92-91006) Avail: CASI HC A04/MF A01

The development of a computational process for solving parabolic flow problems is examined. The solution algorithm presented is checked for very simple geometries. It shows satisfactory results for a straight orthogonal channel. ESA

N92-21234# Duisburg Univ. (Germany). Fachbereich Maschinenbau.

BOUNDARY LAYER FLOW IN AXIAL COMPRESSORS (THEORETICAL PART) Final Report, Jan. 1985 - Dec. 1986 [RANDZONENSTROMUNG IN AXIALVERDICHTERN (THEORETISCHER TEIL). ABSCHLUSSBERICHT, JAN. 1985 - DEC. 1986]

H.-J. DOHMEN and M. JANSSEN 1986 97 p In GERMAN
(Contract T/RF42/E0013/E1413)
(ETN-92-91008) Avail: CASI HC A05/MF A02

A general differential equation is introduced into a set of conservation equations. The mathematical reprocessing of the fundamental equations for the numerical process is represented using this equation. The transformation of the equation into a general curvilinear coordinate system is explained in detail. The theoretical principles that are necessary for the automatization of the process of net generation are presented. Difficulties associated with net generation are discussed. The solution algorithm for the numerical simulation of flow computation is presented. The algorithm for net generation transformation and flow computation is explained using flow schemes. ESA

N92-21704# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

ENHANCED NUMERICAL INVISCID AND VISCOUS FLUXES FOR CELL CENTERED FINITE VOLUME SCHEMES
ALBRECHT EBERLE Jul. 1991 10 p Presented at the 4th International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(MBB-FE-211/S/PUB/458/0; ETN-92-90999) Copyright Avail: CASI HC A02/MF A01

The most attractive features of cell centered finite volume schemes seem to be the easy introduction of the solid body boundary condition and the implementation of characteristic based methods for evaluating the convective fluxes at the cell faces of the finite volumes. For the viscous parts of the fluxes, however, cell centered finite volume schemes are not as well suited as cell vertex based discretizations since in a general grid, cell centered schemes usually are not linear flow preserving concerning the viscous terms. That means that the viscous stress tensor and the heat flux vector may spuriously vary in a flow field with linear velocity and/or temperature distribution. Several enhancements of the flux formulations for cell centered finite volume schemes are described. ESA

N92-21742# Rolls-Royce Ltd., Derby (England). Theoretical Science Group.

PRACTICAL APPLICATION OF 3-D CFD METHODS TO GAS TURBINE COMBUSTORS

JOHN COUPLAND 1 Aug. 1990 25 p Presented at the Cranfield Gas Turbine Combustion Course, England, 6 Jul. 1990 (PNR-90773; ETN-92-90763) Copyright Avail: CASI HC A03/MF A01

The objective of the application of three dimensional Computation Fluid Dynamics (CFD) methods is to assist the design and development process by proving reasonable predictions of combustor flows at a reasonable cost and in a reasonable time. Some of the features that have to be considered in a practical CFD system, are described and some idea of the sort of problems

being tackled on the gas turbine industry using these methods is given. Specifically the following are covered: mesh generation techniques, boundary conditions, turbulence modeling, combustion modeling, output display, combustor flow applications, some other geometries of interest, future developments. ESA

N92-21763# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

VORTEX MOTION IN ROTATING SUPERFLUID HE-3-B

E. B. SONIN, Y. KONDO, J. S. KORHONEN, and M. KRUSIUS
23 May 1991 20 p
(PB92-134162; ISBN-951-22-0648-X) Avail: CASI HC A03/MF A01

Using nuclear magnetic resonance (NMR) techniques, two modes in the temporal response of B-phase vortices were observed: (1) a large readjustment of vortex density occurs in about 10 sec; and (2) small changes near equilibrium are associated with exponentially damped relaxation of about 1-4 min. The latter represents an overdamped collective mode of the vortex array, governed by elasticity and pinning. As in superconductors, at large vortex density, pinning becomes a collective effect, reflecting the rigidity of the ordered vortex lattice. GRA

N92-21955# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

MEASUREMENT OF THE FLOW DISTRIBUTION OVER THE FLIGHT DECK OF AN AIRCRAFT CARRIER

M. MULERO and F. GOMEZ PORTABELLA In AGARD, Aircraft Ship Operations 12 p Nov. 1991
Copyright Avail: CASI HC A03/MF A03

A study was conducted on the general configuration of the air flow over the flight deck of a Spanish aircraft carrier. The level was determined of fluctuations of the wind vector in certain points of the deck where operations of VSTOL planes and helicopters take place. It was decided to study the possibility of making wind tunnel testing over a reduced scale model of the ship and later take some limited data over the actual ship. Preliminary tests to assess the validity of the simulation of the main flow features in the wind tunnel were performed over a simple square cube and they showed a systematic constancy in the shape of the cavity and the wake as a function of the Reynolds numbers studied. Tests were then performed on a reduced scale model of the ship and data were gathered by means of hot film probes and by photographing wool tufts attached to the surface of the model. Results show separation past the leading edge of the ramp, which produces vortices that trail along and over the deck to distances that depend on the direction of the approach wind. Limited data of local velocities and direction in the horizontal plane were obtained over the real ship, which show the highly disturbed flow. Author

N92-22099# Rolls-Royce Ltd., Derby (England).

THE PROBLEM OF STATIC PRESSURE MEASUREMENT IN TURBOMACHINERY ANNULI USING TRAVERSABLE INSTRUMENTATION

P. D. SMOUT 1 Nov. 1990 18 p
(PNR-90791; ETN-92-90844) Copyright Avail: CASI HC A03/MF A01

Traverse probes are used in a component rig and engine testing to measure a range of aerodynamic quantities. Of these quantities, static pressure is the least accurately indicated towards the wall of introduction. Three particularly problematic areas in the measurement of static pressure using specifically the wedge type traverse probe are explained, the discussion drawing on the findings of several researches in addition to 'in house' experience. In view of the importance of an accurate knowledge of the static pressure field in determining turbomachine performance and efficiency levels, an experimental and theoretical study was planned. With the ultimate goal of understanding the root causes of the static pressure measurement problem, details of this study are presented, a study which it is hoped will lead to an elimination of this fundamental problem, either through reviewed calibration procedures, or through new probe designs. ESA

N92-22100# Manchester Univ. (England). Dept. of Engineering.
VORTICITY MEASUREMENTS IN THE NEAR WAKE OF A BLUFF BODY AT LOW REYNOLDS NUMBERS

R. B. GREEN and J. H. GERRARD Jul. 1991 27 p Sponsored by Science Research Council and Medical Research Council (AERO-REPT-9102; ETN-92-90933) Avail: CASI HC A03/MF A01

The technique of particle image velocimetry was applied to the study of bluff body wakes at low Reynolds number. Vorticity and shear stress were measured to an accuracy of 15 to 20 pct. The vortex shedding cycles at Reynolds numbers of 73 and 226 are shown and the differences between the two are highlighted. Quantitative descriptions of the previously described vortex splitting phenomenon in the near wake are made, leading to a description of the vortex shedding mechanism at low Reynolds number. A low Reynolds number formation region length is proposed. The strength of shed vortices obtained from integration of the vorticity is compared with directly measured vortex strengths. ESA

N92-22121# Ecole Polytechnique Federale de Lausanne (Switzerland).

ON THE DETERMINATION OF TURBULENT MIXING COEFFICIENTS FROM EULERIAN CURRENT DATA

U. LEMMIN, Z. VESCERNYES, and WALTER H. GRAF *In its Activities Report of the Laboratory of Hydraulic Research* 26 p 1990

Avail: CASI HC A03/MF A02

Based upon Eulerian current measurements an investigation of turbulent mixing dynamics in Lake Geneva (Switzerland) was carried out. High frequency current fluctuation components were determined by filtering the synoptic data. By means of a sensitivity analysis, the filtered data were investigated. Their turbulence characteristics related to the selected frequency ranges was considered. Stationary, isotropic turbulence is found to be limited to time scales being less than 0.5 d. The average mixing coefficients, A sub H when limited to timescales being less than 0.5 d show little difference between each other. They are one to two orders of magnitude below estimates from the Laurentian Great Lakes (North America) and the ocean. The time variation of the mixing coefficients, being three orders of magnitude, is explained by the dominant effect of wind forcing. ESA

N92-22200 Liverpool Univ. (England).

BOUNDARY LAYER TRANSITION ON CONCAVE SURFACES Ph.D. Thesis

FAROUK H. HACHEM 1989 294 p
 Avail: Univ. Microfilms Order No. BRDX94041

Using a hot wire anemometer system, the laminar development and transition of a boundary layer on a concave surface was studied. The start and end of transition results were obtained using an algorithm for determining the intermittency factor which did not require calibration. Measurements were done at free stream turbulence levels of 0.7 percent and 2.6 percent. Three flow visualization techniques were employed to show the formation and development of Taylor Gortler vortices and to identify the transition position on the concave surface. The boundary layer profile was observed to be highly distorted by the momentum transfer associated with the vortices. This distortion has the effect of increasing the boundary layer growth rate and modifying the start of transition momentum thickness Reynolds numbers from the typical value of the flat plate. For modest curvatures, the vortices carry turbulence towards the blade which promises transition, but as the curvature is increased further, the boundary layer profile shape is stabilized and transition is delayed. A model for the distorted boundary layer is presented and is used to predict the boundary layer growth rate and correlate the start of transition results in terms of the momentum thickness and blade radius Reynolds number and the free stream turbulence level.

Dissert. Abstr.

N92-22209# Cambridge Univ. (England). Dept. of Engineering.
SEPARATION OF RELAMINARISED BOUNDARY LAYERS

RUNE BRANDT and M. GASTER Oct. 1991 104 p
 (CUED/A-AERO/TR-16; ISBN-0309-7293; RAE-2029/236) Avail: CASI HC A06/MF A02

A series of experiments have been performed using a new experimental rig. This rig is capable of producing accelerations and decelerations of a boundary layer on a flat plate. The boundary layer developed initially in a zero pressure gradient was subjected to pressure gradients similar to those observed on leading edges of wings at high angles of attack. The data obtained will be useful for validating methods for predicting such flows. Among the tests performed are: varying the initial momentum-thickness Reynolds number; skin friction measurements; velocity and turbulence intensity profiles; and flow separation and reattachment. H.A.

N92-22788# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

NUCLEATION OF VORTICES AT THE A-B PHASE BOUNDARY IN SUPERFLUID HE-3: NONCONSERVATION OF CIRCULATION AND VORTICES WITH SOLITON TAILS IN THE B PHASE

Y. KONDO, M. KRUSIUS, E. V. THUNEBERG, J. S. KORHONEN, and V. V. DMITRIEV 9 May 1991 18 p Prepared in cooperation with Academy of Sciences (USSR), Moscow
 (PB92-134170; TKK-F-A688; ISBN-951-22-0649-8) Avail: CASI HC A03/MF A01

The reversible A reversible to B phase transitions under rotation was studied with nuclear magnetic resonance techniques. The A yields B transition gives rise to a B phase state which contains: (1) only half of the equilibrium number of vortices; and (2) theta solitons attached to combined vortex disclination lines. The B yields A transition leads to the usual equilibrium state of continuous vortices. The observations support the hypothesis that only one half of a doubly quantized A phase vortex transforms to a singular B phase vortex at the A-B interface. Author

N92-23120# Oak Ridge National Lab., TN.

HEAT PUMP SYSTEMS WITH DIRECT EXPANSION GROUND COILS

O. J. SVEC and V. D. BAXTER 1991 22 p Presented at the 4th Conference and Equipment Show: Meeting Customers Needs With Heat Pumps, Dallas, TX, 15-18 Oct. 1991
 (Contract DE-AC05-84OR-21400)
 (DE92-007831; CONF-911080-1) Avail: CASI HC A03/MF A01

This paper is a summary of an International research project organized within the framework of the International Energy Agency (IEA), Implementing Agreement on Heat Pumps. This cooperative project, based on a task sharing principle, was proposed by the Canadian team and joined by the national teams of the United States of America, Japan and Austria. The Institute for Research in Construction (IRC) of the National Research Council of Canada (NRCC), has been acting as the Operating Agent for this project, known as Annex XV. The need for this research work is based on the recognition of the state-of-the-art of Ground Source Heat Pump (GSHP) technology, which can simply be described by the following two statements: (1) GSHP technology is the most successful among all renewable technologies in North American and northern European countries; and (2) installation cost of GSHP systems is currently too high for a meaningful worldwide penetration into the heating/cooling market. DOE

N92-23149 Bristol Univ. (England).

APPLICATIONS OF BOUNDARY INTEGRAL METHODS TO THE STUDY OF STEEP FREE SURFACE WAVES Ph.D. Thesis

A. F. TELES DASILVA 1989 199 p

Avail: Univ. Microfilms Order No. BRDX94110

Boundary Integral Methods are applied to the study of three problems on two dimensional steep surface waves. The first problem is on the propagation of steady waves moving on a shearing flow with constant vorticity. Steady solutions which are either spacially periodic or solitary waves are calculated up to the limiting wave with and angle of 120 deg at its crest. The second problem is on the unsteady development of bores. Bores are studied as an evolution problem starting from an initially smooth

wave of elevation. For weaker bores, the growth of undulations is studied in detail; stronger bores are followed until they break. Calculated results are compared with experiments with a general good agreement. The third problem is on the interaction of a submerged cylinder and a free surface flow. The flow produced by an obstacle of finite dimensions fixed in an otherwise uniform stream is calculated for several sizes of the obstacle and different values of the Froude number. Also studied are the disturbances produced on an initially flat water surface by a moving submerged cylinder. Dissert. Abstr.

N92-23251# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.

IMPROVED SHOCK-CAPTURING OF JAMESON'S SCHEME FOR THE EULER EQUATIONS

J. W. VANDERBURG, J. G. M. KUERTEN, and P. J. ZANDBERGEN Sep. 1991 29 p (PB92-148758; MEMO-997) Avail: CASI HC A03/MF A01

It is known that Jameson's scheme is a pseudo-second-order accurate scheme for solving discrete conservation laws. The scheme contains a nonlinear artificial dissipative flux which is designed to capture shocks. It is shown that the shock-capturing of Jameson's scheme for the Euler equations can be improved by replacing the Lax-Friedrichs' type of dissipative flux with Roe's dissipative flux. The replacement is at a moderate expense of the calculation time. GRA

N92-23843# Kreis Consultancies, Pragg-Jenaz (Switzerland). **ON THE ANALYSIS OF LIQUID FILLED FREE-FREE TANKS** ANDREAS KREIS (Kreis Consultancies, Pragg-Jenaz (Switzerland).) and MICHEL KLEIN (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 437-442 Oct. 1991

Copyright Avail: CASI HC A02/MF A04

The problem of analysis of free-free flexible tanks filled with an incompressible fluid is discussed. Gravity effects due to thrust forces are considered both for the fluid and the structure. A numerical analysis methodology is presented which uses the boundary element method for the fluid model and the finite element method for the structural model. For the analysis of free-free tank fluid systems under gravity conditions it is essential to include the rigid degrees of freedom explicitly in the model in order to get a correct rigid mode behavior. Besides numerical solutions, two benchmark problems are presented which were solved analytically by means of Fourier series expansions. Only two dimensional problems are discussed although the generalization to three dimensions is straightforward. ESA

N92-23844# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).

NUMERICAL INVESTIGATION OF FLUID-STRUCTURE-INTERACTION PROBLEMS WITH THE FINITE ELEMENT METHOD

H.-P. FLICKE and W. MOHR In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 443-449 Oct. 1991

Copyright Avail: CASI HC A02/MF A04

A procedure for the description and solution of Fluid Structure Interaction (FSI) problems is presented. In contrast to many other approaches a complete coupling of the fluid with the structure is obtained. The derived eigenvalue problem of the coupled system is solved with a modified subspace iteration method. The time integration is performed with the method of modal superposition. In two examples the influence of the FSI on the eigenfrequencies of mechanical systems is shown. ESA

N92-23846# Universite de Technologie de Compiègne (France). DAVI Centre de Recherche de Royallieu.

A SYMMETRIC COUPLING BETWEEN BEM AND FEM FOR DYNAMICAL ANALYSIS OF SPACECRAFT

A. OMRANI (Universite de Technologie de Compiègne (France).) and M. A. HAMDI (STRACO S.A., Compiègne, France) In ESA,

Spacecraft Structures and Mechanical Testing, Volume 1 p 457-460 Oct. 1991

Copyright Avail: CASI HC A01/MF A04

In modern spacecraft, a large percentage of the total mass consists of fluids. For satellites, this percentage can go up to 50 percent, and can be even higher for launcher elements (90 percent for an Ariane 5 central body). To control the spacecraft behavior the phenomena of liquid sloshing for partially filled tanks and hydroelastic modes must be taken into account. To predict these phenomena a convenient mathematical fluid modeling is required. A fluid modeling formulation based on coupled BEM/FEM (Boundary Element Method/Finite Element Method) technique in order to calculate sloshing modes is proposed. ESA

N92-24341# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

BOUNDARY LAYERS AND TRANSITION ON CONCAVE SURFACES

R. I. CRANE In VKI, Boundary Layers in Turbomachines 47 p 1991

Avail: CASI HC A03/MF A04

Fundamental aspects of the influence of longitudinal concave wall curvature on laminar and turbulent boundary layers are described. The controlling parameters are introduced. The phenomenon of Goertler instability in laminar layers is covered, including evidence for its occurrence in turbomachines, experimental studies and prediction of Goertler vortex amplification, and the effect in boundary layer growth. Transition in concave surfaces is dealt with. Experiments and attempts to devise new correlations are reviewed. The prospects for improved prediction methods are considered. The effects of concave curvature on laminar and turbulent convective heat transfer and on film cooling are described. ESA

N92-24342# Advanced Scientific Computing G.m.b.H., Holzkirchen (Germany).

NUMERICAL PREDICTION OF BOUNDARY LAYERS AND TRANSITIONAL FLOWS

GEORG SCHEUERER In VKI, Boundary Layers in Turbomachines 73 p 1991

Avail: CASI HC A04/MF A04

Mathematical models and numerical prediction methods for two dimensional boundary layer flows in turbomachines are reviewed. Special emphasis is given to the prediction of laminar turbulent transition, transitional flow and relaminarization. The various physical phenomena affecting the development of blade boundary layers are discussed. The various forms of laminar turbulent transition are physically described. A general classification of mathematical models for predicting transitional boundary layer flows is provided. Statistical turbulence models are discussed in detail. A brief survey of numerical solution methods used for boundary layer flows is presented. Examples of transitional and blade boundary layer calculation using a kappa epsilon low Reynolds number turbulence model are given. The state of the art of 'direct numerical simulations' of transitional and turbulent flows is briefly discussed. ESA

N92-24343# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

BOUNDARY LAYER TRANSITION UNDER THE PRESENCE OF DISCRETE FREQUENCIES IN THE FREESTREAM TURBULENCE SPECTRUM

JORGE COSTA and TONY ARTS In its Boundary Layers in Turbomachines 46 p 1991

Avail: CASI HC A03/MF A04

Forced transition flow in a low speed wind tunnel along a flat test surface was studied. The receptivity of the boundary layer flow to the acoustic excitation frequency was evidenced both by the frequency dependent transition Reynolds number and the streamwise intermittency factor distribution. The intermittency measurements were performed using a conditional sampling technique, which includes a new approach to the positioning of the laminar/turbulent status decision threshold. A model providing

an estimation, within the transition region, of the turbulence level profiles and the skin friction coefficient is proposed. The growth of selected oscillation modes are compared in a natural and a forced transition situation. ESA

N92-24392# Gesamthochschule, Essen (Germany). Lehrstuhl fuer Stroemungslehre.

INTERACTION BETWEEN SHOCK WAVE AND TUBULAR FLOW [WECHSELWIRKUNG ZWISCHEN EINER STOSSWELLE UND EINER TURBULENTEN STROEMUNG]

W. MERZKIRCH /In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 107 Dec. 1990 In GERMAN
Avail: CASI HC A01/MF A02

The interaction between a shock wave and a compressible turbulent flow is investigated in a shock tube using laser speckle photography. The aim is to determine how the characteristics of the turbulent flow can be changed due to the compression by the shock wave, with a view to the aerodynamics of spacecrafts on which turbulent boundary layers develop. Preliminary results show an enhancement of the turbulence intensity by an order of magnitude in the range of low wave numbers, while the higher turbulence frequencies intensities do not seem to be enhanced. ESA

N92-24515*# Manchester Coll. of Science and Technology (England).

TURBULENCE MODELLING IN CFD: PRESENT STATUS, FUTURE PROSPECTS

BRIAN E. LAUNDER /In NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling p 7-16 Mar. 1992
Avail: CASI HC A02/MF A04

Information is given in viewgraph form for turbulence modeling in computational fluid dynamics (CFD). The Eddy Viscosity Models (EVM), Algebraic Second Moment Closures (ASM), and Differential Second-Moment Closures (DSM) are considered. It is concluded that EVM's, ASM's, and DSM's will remain in use, though with a steady decline in importance of EVM's and ASM's in favor of DSM's. Improved versions of low-Re two-equation EVM's should lead to more reliable predictions of separated flows than are achievable at present. Further refinement of sub-models in second moment closures can be expected throughout this decade. There will be increasing attention given to interfacing SMC with higher order approaches such as LES, and an increased use of two-time-scale schemes providing distinct time scales for large and fairly small eddies. Author

N92-25897# Dornier System G.m.b.H., Friedrichshafen (Germany).

APPLICATION OF CFD TOOLS IN SPACE PROJECTS

E. EMBACHER and M. HUCHLER /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 529-535 Dec. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

In recent years the design of spacecrafts became more and more complex. So called two phase loops, are used for thermal control where high heat rates have to be transferred. Many material experiments with fluids forming homogeneous crystals were performed or planned. At least the ventilation of manned spacecrafts as well as the detection of undesirable conditions are essential problems of today's space flight programs. To understand the physical context, to design spacecraft components or experiments and to adapt them to the special microgravity environment, it is inevitable to perform fluid dynamic analyses. Selected Computation Fluid Dynamics (CFD) applications performed on various projects are presented. ESA

N92-26507# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

MUTUAL FRICTION IN SUPERFLUID HE-3: EFFECTS OF BOUND STATES IN THE VORTEX CORE

N. B. KOPNIN and M. M. SALOMAA 1991 29 p Sponsored in part by Suomen Akatemija, Helsinki; and Akademiya Nauk SSSR, Moscow (USSR)
(PB92-142231; TKK-F-A673) Avail: CASI HC A03/MF A01

The motion of singular quantized vortex lines in superfluid He-3 is considered for the A and B phases. Mutual friction is calculated within a microscopic quantum-mechanical Green's function formalism, valid for dynamical processes. This enables one to include all the different physical phenomena in a unified approach. The authors consider axisymmetric vortices for temperatures considerably lower than T(c). In the regime, the main contribution to the force exerted on a moving vortex line originates from the localized Fermi excitations occupying quantized energy eigenstates in the vortex core. These He-3 quasiparticle states are similar to the quantized motion of charge in a magnetic field. Thus, vortex motion in He-3 resembles the Hall phenomena in metals. The authors also discuss vortex oscillations and predict that strong dissipation should be observed at a resonant frequency of about 10 kHz, owing to transitions between the bound-state energy levels. The effect should be used for detecting and measuring the quantization of the quasiparticle bound-state spectrum in the vortex-core matter for superfluid He-3. Author

N92-26599 Oxford Univ. (England).

CELL VERTEX METHODS FOR COMPRESSIBLE GAS FLOWS Ph.D. Thesis

MICHAEL A. RUDGYARD 1990 181 p
Avail: Univ. Microfilms Order No. BRD-94193

The application of cell vertex, finite volume methods to the steady Euler equations is addressed. We consider simple test problems in both one and two dimensions, in order to develop our understanding of the scheme. We present numerical results for the Euler equations for subsonic, transonic, and hypersonic flows. In chapter 1, a background survey of the Euler equations is presented. Chapter 2 contains a review of relevant numerical techniques. In particular, we consider the class of finite volume methods. In chapter 3, we consider the cell vertex method applied to inhomogeneous equations in a single space dimension. We also examine a Lax-Wendroff time-stepping method and deduce a simple modification to this. In chapter 4, we discuss the application of the cell vertex scheme to 2-D problems. We analyze the basic discretization using Fourier techniques, for both hyperbolic and elliptic problems. Iterative methods based on a Lax-Wendroff time-stepping scheme are developed and these are combined with multigrid acceleration. In chapter 5, we develop shock recovery techniques which may be used in combination with Lax-Wendroff time-stepping. This technique is generalized to systems of equations in higher dimensions. The use of upwind iteration methods and the cell vertex scheme is examined in chapter 6. Other iterative methods are considered, including an efficient sweeping technique. In chapter 7, we attempt to generalize the upwind scheme to two dimensions, for both scalar, and vector unknowns. We examine basic properties of the cell vertex scheme, as well as the iterative techniques that are used to solve it. Dissert. Abstr.

N92-27027# Erno Raumfahrttechnik G.m.b.H., Bremen (Germany).

CONJUGATING BINARY SYSTEMS: ADVANCED COOLING LIQUIDS FOR USE IN SPACECRAFT ATCS

P. L. MUELLER-REMMERS (Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.)), H. PAPENBERG (Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.)), W.-D. EBELING (Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.)), M. HUERTH (Institut fuer Physikalische Weltraumforschung, Freiburg (Germany, F.R.)), D. WOERMANN (Institut fuer Physikalische Weltraumforschung, Freiburg (Germany, F.R.)), J. GMEHLING (Oldenburg Univ. (Germany, F.R.)), and W. SUPPER (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1157-1162 Dec. 1991

(Contract ESTEC-8757/90/NL/PP(SC))

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The drastic increase of the specific heat of Conjugating Binary Systems (CBS) very near to the critical temperature resulting in an enhanced heat transport capability is of interest with respect to the heat transport capabilities of standard ATCS. An almost complete list of CBS (status end 1990) with suitable chemical properties and suitable values of the critical temperature was selected from a database of thermodynamic data. A simple procedure was developed to determine the temperature dependence of the specific heat and the excess specific heat of CBS around the critical temperature. The CBS finally analyzed show maximum specific heat data in the range of water or freezing points in the range of water freezing points in the range of R114 or dynamic properties (density, dynamic viscosity and thermal conductivity) better or equal than those of the reference systems. Future investigations are proposed. ESA

N92-27450# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.

CFD TECHNIQUES FOR PROPULSION APPLICATIONS [LES TECHNIQUES DE L'AERODYNAMIQUE NUMERIQUE POUR LES APPLICATIONS AUX PROPULSEURS]

Feb. 1992 588 p In ENGLISH and FRENCH The 77th symposium was held in San Antonio, TX, 27-31 May 1991 Original contains color illustrations (AGARD-CP-510; ISBN-92-835-0659-6; AD-A253647) Copyright Avail: CASI HC A25/MF A06

The symposium was composed of the following sessions: turbomachinery computations and validations; flow in ducts, intakes, and nozzles; and reacting flows. Forty papers were presented, and they covered full 3-D code validation and numerical techniques; multidimensional reacting flow; and unsteady viscous flow for the entire spectrum of propulsion system components. The capabilities of the various numerical techniques were assessed and significant new developments were identified. The technical evaluation spells out where progress has been made and concludes that the present state of the art has almost reached the level necessary to tackle the comprehensive topic of computational fluid dynamics (CFD) validation for propulsion.

N92-27451# Technische Hochschule, Aachen (Germany). Aerodynamisches Inst.

COMPUTATIONAL TECHNIQUES FOR SOLVING THE NAVIER-STOKES EQUATIONS

D. HAENEL In AGARD, CFD Techniques for Propulsion Applications 26 p Feb. 1992 Copyright Avail: CASI HC A03/MF A06

Computational techniques for the solution of the Navier-Stokes equations of compressible flows are addressed. In the first section, the governing equations and their most important approximations are described. A review of computational techniques encloses grid arrangement, conservative discretization, numerical flux formulations, and different methods of solution inclusive multigrid methods. In the last section, the influence of the numerical discretization on the accuracy of Navier-Stokes solutions is briefly discussed. Author

N92-27452# Royal Aerospace Establishment, Farnborough (England). Propulsion Dept.

APPLICATION OF S1BYL2 TO THE AGARD WG18 COMPRESSOR TEST CASES

W. J. CALVERT In AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Previously announced as N91-30147

Copyright Avail: CASI HC A03/MF A06

S1BYL2 is an inviscid-viscous blade-to-blade method for calculating the detailed aerodynamics and overall performance of compressor blades. It may be applied either on its own to predict the flow for individual blade sections, such as the midspan of a linear cascade, or in conjunction with a throughflow calculation to

predict the performance of a complete axial compressor. New predictions for the V2 and ARL SL19 cascades and for the high speed compressor cases are presented. It is hoped that this will be one of many sets of calculations for these cases, so that an improved understanding of each case may be obtained, together with an appreciation of the strengths and weaknesses of different computational approaches. Author

N92-27454# Genoa Univ. (Italy). Dipartimento di Ingegneria Energetica.

TIME-MARCHING METHODS FOR SECONDARY FLOW ANALYSIS IN CURVED DUCTS

M. MARINI, A. MASSARDO, and A. SATTA In AGARD, CFD Techniques for Propulsion Applications 7 p Feb. 1992 Copyright Avail: CASI HC A02/MF A06

Compressible rotational flows in curved ducts due to inlet total pressure gradients are analyzed. Two different time-marching methods are briefly presented and utilized for the analysis of the development of 3-D flows. The former is a finite volume explicit method, and the latter is a finite difference implicit method. These methods are successfully compared to each other and with other methods. A first analysis of secondary flows concerning constant section curved ducts with a curvature of 90 degrees is performed. Author

N92-27457# Durham Univ. (England). School of Engineering and Applied Science.

EXPERIMENTAL VERIFICATION OF A 3D TURBULENT FLOW CALCULATION IN AN AXIAL TURBINE CASCADE

J. G. E. CLEAK (Durham Univ. (England).), D. G. GREGORY-SMITH (Durham Univ. (England).), and N. T. BIRCH (Rolls-Royce Ltd., Derby, England) In AGARD, CFD Techniques for Propulsion Applications 15 p Feb. 1992 Sponsored in part by Rolls-Royce Ltd. and Science Research Council

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A Navier-Stokes computer code was used for the calculation of the 3-D secondary flow in a cascade of axial turbine blades. A comparison is made with experiment of the results of various applications of a mixing length model within the code. The results are compared on the basis of mean flow data and also turbulent Reynolds shear stresses. Substantial grid independence was obtained with a grid of 20,000 points; further grid refinement had a significant effect only on midspan loss. Large variations in the results were obtained with laminar flow being imposed for up to 80 percent of the axial chord away from the end wall. The high turbulence activity in the vortex core was not predicted; the flow close to the endwall and blade surfaces appeared to dominate the calculated flow. The need for higher order turbulence modeling is indicated, but probably of greater importance is the accurate prediction of transition. Author

N92-27460# Paris VI Univ. (France).

ON THE COMPUTATION OF UNSTEADY TURBOMACHINERY FLOWS. PART 1: EULER EQUATIONS IN VIBRATING CASCADES

GEORG A. GEROLYMOS In AGARD, CFD Techniques for Propulsion Applications 19 p Feb. 1992 Sponsored in part by SNECMA

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A methodology is presented for unsteady flow analysis in vibrating transonic compressor cascades, using Euler equations. After a brief discussion of the problem, the numerical algorithm is presented, for the 3-D case, with particular emphasis on grid displacement procedures, slip surface fitting, boundary conditions, and their effect on computational results. Chorochronic flow periodicity and model superposition are briefly discussed. Several results from realistic aircraft engine turbomachinery configurations are presented. The lack of, and urgent need for 3-D experimental data combining unsteady pressure measurements and vibrating mode shapes are stressed. The methods are then validated through comparison with time linearized flat plate cascade theory (analytical) and experimental data from annular and linear cascades. A method

for computing the aeromechanical coupling is presented. Finally, a discussion is presented of viscous effects. Author

N92-27470# National Technical Univ., Athens (Greece). Lab. of Thermal Turbomachines.

UNSTEADY EULER CALCULATIONS IN 3D INTERNAL AERODYNAMICS

M. HADZIDAKIS, F. KARAGIANNIS, P. CHAVIAROPOULOS, and K. D. PAPAILIOU /in AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992

Copyright Avail: CASI HC A02/MF A06

An implicit finite difference algorithm is presented which solves the unsteady Euler equations in three dimensional ducts. The Helmholtz decomposition is examined of the unsteady velocity field into a potential and a rotational part. The geometry does not change with time, thus the unsteady nature of the flow is due to the time dependent inflow and outflow boundary conditions. The flow at the inlet is supposed to be rotational. Vorticity is introduced by means of velocity, total enthalpy, or even entropy profile slope. The results cover a wide range of reduced frequencies in the subsonic flow regime. Author

N92-27471# Rolls-Royce Ltd., Derby (England).

THE APPLICATION OF A NAVIER-STOKES CFD METHOD TO CIVIL ENGINE INTAKE FLOWS

N. T. BIRCH (Rolls-Royce Ltd., Derby (England).), E. H. KITCHEN (Rolls-Royce Ltd., Derby (England).), and R. J. G. NORTON (Rolls-Royce, Inc., Atlanta, GA.) /in AGARD, CFD Techniques for Propulsion Applications 10 p Feb. 1992 Sponsored in part by Ministry of Defence

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Three-dimensional flows around civil engine intakes were calculated by a Navier-Stokes method. The full Reynolds-averaged Navier-Stokes equations for viscous flow are solved by an explicit time-marching cell-centered finite-volume algorithm. To ensure numerical stability, Jameson's formulation of fourth-order and second-order smoothing is used. Second-order smoothing is switched on only in regions of strong pressure gradient such as shocks. The flow may be laminar or turbulent; turbulence is treated by a mixing-length eddy viscosity model. The algorithm is applied on a body-fitted C-type computational grid. Author

N92-27472# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CFD CONTRIBUTIONS DURING HYPERSONIC AIRPLANE INTAKE DESIGN

N. C. BISSINGER and A. EBERLE /in AGARD, CFD Techniques for Propulsion Applications 24 p Feb. 1992 Sponsored in part by BMFT

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Above certain Mach numbers, flows in wind tunnels can no longer fully simulate the actual flow physics. In the design of optimal propulsion systems, which are capable of economically propelling aircraft to hypersonic Mach numbers, understanding of the 'real' flow is mandatory. This paper will address recently developed numerical elements of an advanced CFD code in terms of computational speed and accuracy. Results will be presented of several calculations performed to gain insight into the flow in hypersonic intakes. Author

N92-27475# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

PRESENTATION OF A COMPUTATIONAL CODE FOR 3-D COMPRESSIBLE FLOW IN COMPLEX CHANNELS AND CAVITIES [PRESENTATION D'UN CODE DE CALCUL D'ÉCOULEMENTS COMPRESSIBLES 3-D DANS DES CANAUX ET DES CAVITÉS DE FORME COMPLEXE]

D. DUTOYA, M. ERRERA, P. J. MICHARD, and A. RISTORI /in AGARD, CFD Techniques for Propulsion Applications 21 p Feb. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A91-45650

Copyright Avail: CASI HC A03/MF A06

A computation code named MATHILDA was developed at

ONERA to study mass and energy transfer through internal cooling systems composed of complex shaped channels and cavities in which the flow is controlled by the interaction between inertial forces and irreversible phenomena. This code integrates the 3D time dependent Navier-Stokes equations, along with some additional transfer equations. The fluid is compressible, and flow may vary from low subsonic to supersonic. The turbulence model can be either a two-equation model or an algebraic model. Author

N92-27476# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.

VALIDATION OF NON-ORTHOGONAL THREE-DIMENSIONAL LAMINAR FLOW PREDICTIONS

P. J. COELHO and J. C. F. PEREIRA /in AGARD, CFD Techniques for Propulsion Applications 12 p Feb. 1992

Copyright Avail: CASI HC A03/MF A06

Most of the flow geometries for aeronautical engineering are complex and cannot be discretized using orthogonal coordinates. In addition, some of those flows can only be described in the fully developed form of the Navier-Stokes equations. In this paper the Navier-Stokes equations are solved for three-dimensional complex geometries using a non-orthogonal, non-staggered coordinate system. The strong conservation form of the governing equations for laminar flows is discretized using a finite volume method. A numerical grid generation method is employed in order to easily generate the meshes. The flow through a square diffuser, the flow through a transforming duct of elliptical cross-section, and the flow through a square cross-section S-shaped duct were analyzed. The predictions reveal good agreement with the available data demonstrating the accuracy and generality of the present method. The present solution algorithm can easily be extended to calculate subsonic compressible flows. Author

N92-27479# Technische Univ., Aachen (Germany). Inst. for Jet Propulsion and Turbomachinery.

APPLICATION OF FINITE ELEMENT METHOD TO HYPERSONIC NOZZLE FLOW COMPUTATIONS

W. KOSCHEL, W. RICK, and S. BIKKER /in AGARD, CFD Techniques for Propulsion Applications 14 p Feb. 1992 Sponsored in part by DFG

Copyright Avail: CASI HC A03/MF A06

An explicit Taylor-Galerkin Finite Element Method (FEM) algorithm, used for the solution of Euler/Navier-Stokes equations, is applied for the computation of steady-state frozen equilibrium flow in single expansion ramp nozzles (SERN) and in plug nozzles for hypersonic propulsion systems. External flow conditions are taken into account. For the determination of nozzle performance a detailed 2D/3D-flow analysis in regions with complex geometries was performed using unstructured computational grids with adaptive mesh refinement. Some results for the investigated nozzle configurations at different flight conditions are presented and discussed. Additionally, thrust vectoring by modification of the lower nozzle flap shape was studied. Author

N92-27480# Manchester Coll. of Science and Technology (England). Dept. of Mechanical Engineering.

COMPUTATIONAL MODELLING OF TURBULENT FLOW IN S-BENDS

N. I. ABOU-HAIDAR, H. IACOVIDES, and B. E. LAUNDER /in AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Sponsored in part by Rolls-Royce Ltd.

(Contract GR/F/70495)

Copyright Avail: CASI HC A03/MF A06

The paper considers the computation of turbulent flow through circular sectioned S-bends, a flow generically similar to those arising in various types of jet-engine intake ducting. A fully elliptic, finite-volume discretization of the Reynolds equations is adopted. For the main part of the flow the standard algebraic second-moment (ASM) closure is adopted while over the thin, viscosity-affected sublayer, adjacent to the wall, three types of model were explored: namely, one- and two-equation eddy viscosity models and a two-equation ASM closure. Although the main features of the flow

development are well captured even with the simplest near-wall treatment, the pressure drop through the second half of the S-bend is seriously underestimated. The successive refinement of the model across the sublayer is found to bring the computed behavior into very close accord with the detailed experimental data. The findings indicate the desirability of using a high-level turbulence model not just in the main part of the flow but across the low-Reynolds-number sublayer also. Author

N92-27481# Aristotle Univ. of Thessaloniki (Greece). Lab. of Fluid Mechanics and Turbomachinery.

THREE DIMENSIONAL FLOW IN SHARP BENDS

K. FOTEA, P. PRINOS, and A. GOULAS /in AGARD, CFD Techniques for Propulsion Applications 12 p Feb. 1992
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The three dimensional flow in sharp bends is computed by solving the fully elliptical three dimensional Navier-Stokes equations in conjunction with a k-epsilon model of turbulence. Computed isovelocity patterns before and after the sharp bend and recirculation lengths are compared with experimental measurements taken with Laser Doppler Anemometry. In general good agreement is obtained although the refinements in the turbulence modelling can improve the predictions. The computational results show that the recirculating region depends strongly on the inlet velocity profile. Finally, an increase in the aspect ratio of the duct indicates an increase of the region of the recirculation. Author

N92-27482# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany).

THE 3-D NAVIER-STOKES FLOW AND TEMPERATURE FIELD COMPUTATION FOR A FORCED MIXER NOZZLE

K. KATHEDER /in AGARD, CFD Techniques for Propulsion Applications 12 p Feb. 1992
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To increase the temperature mixing efficiency in the common nozzle of an existing turbofan engine, a forced mixer is to be developed. Its design is based on empirically derived knowledge and requires some verification testing. To minimize the scope of testing, a numerical investigation has been performed, computing the complete flow path through the mixer up to the thrust nozzle. The computational domain is formed by a body fitted H-type grid. The simulated air flow is compressible adiabatic including variable specific heat and viscosity and the standard k-epsilon model is used. Resulting velocity and temperature fields are presented together with the temperature mixing efficiency. Use of the velocity field to shape the scallops at the mixer trailing edge is demonstrated. Comparison with test results indicates that computational fluid dynamics (CFD) is a useful engineering tool to check and improve a new design before testing. Author

N92-27483# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Inst. of Propulsion Technology.

FLOW COMPUTATION IN COMBUSTION CHAMBERS USING ZONAL NONSTAGGERED GRIDS

M. RACHNER /in AGARD, CFD Techniques for Propulsion Applications 18 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

A Rhie-type nonstaggered grid three dimensional Navier-Stokes Code working on overlaid subdomains by a zonal technique is applied on two model combustion chambers. In the case of the swirling turbulent combustor flow investigated, a locally unrealistic flow behavior at domain boundaries was found on the coarse grid. This is caused by strong overshoots of the momentum interpolated cell mass fluxes, not reported up to now in the literature. The influence of the pressure gradient discretization at boundaries on these overshoots is shown. At inter grid boundaries the discretization of the pressure gradient can give rise to wiggles in the numerical solution as observed in the case of the reacting turbulent crossflow-H2-jet in a rectangular channel. Moreover the influence of fully, partially and lacking local flux conservativity in coupling the numerical fluxes across inter grid boundaries of the

subdomain is studied. The fully conservative coupling scheme turned out be a nonrobust method. Author

N92-27487# Politecnico di Torino (Italy). Dipartimento di Ingegneria Aeronautica e Spaziale.

NONEQUILIBRIUM 3D FLOWS OF AIR THROUGH INLETS

ROBERTO MARSILIO and MAURIZIO PANDOLFI /in AGARD, CFD Techniques for Propulsion Applications 10 p Feb. 1992
Copyright Avail: CASI HC A02/MF A06

The hypersonic nonequilibrium flow of air through inlets of propulsion devices is investigated. The fluid dynamics is described by the Euler equations and a chemical model accounts for finite rate equations. The numerical procedure is based upon a space marching technique, under the hypothesis of fully developed supersonic flow. The conservative form of the Euler and finite rate chemical equations are integrated, following a finite volume discretization and a flux difference splitting procedure. The numerical scheme is of the second order accuracy, with a proper total variation diminishing (TVD) technique to avoid spurious oscillations at flow discontinuities. Numerical results are presented and discussed. Author

N92-27490# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

THREE DIMENSIONAL CALCULATIONS OF REACTIVE FLOWS WITHIN AIRCRAFT COMBUSTION CHAMBERS INCLUDING SOME COMBUSTION MODELS [CALCULS

TRIDIMENSIONNELS D'ÉCOULEMENTS REACTIFS DANS LES CHAMBRES DE COMBUSTION AÉRONAUTIQUES EFFECTUÉS À L'AIDE DE DEUX MODÈLES DE COMBUSTION]

FABIENNE PIT, HELENE TICHITSKY, PASCALE GILBANK, and FRANCIS DUPOIRIEUX /in AGARD, CFD Techniques for Propulsion Applications 15 p Feb. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A92-16089
Copyright Avail: CASI HC A03/MF A06

Some three dimensional calculations have been performed in order to predict the reactive flow within aircraft combustion chambers. Two kinds of combustion models have been tested: on one hand a model which makes the assumption of fast chemistry but can however take roughly into account some aspects of the chemical kinetics through an ignition delay and, on the other hand, the Lagrangian-Eulerian PEUL model which can deal directly with some Arrhenius laws by means of the interaction by exchange with the mean (IEM) submodel and hence does not include some assumptions of fast reaction. Author

N92-27671# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.

SPECIAL COURSE ON UNSTRUCTURED GRID METHODS FOR ADVECTION DOMINATED FLOWS

May 1992 362 p Special course held in Rhode-Saint-Genese, Belgium, 2-6 Mar. 1992 and at Moffett Field, CA, 28 Sep. - 2 Oct. 1992; sponsored in cooperation with VKI (AGARD-R-787; ISBN-92-835-0671-5; AD-A256061) Copyright Avail: CASI HC A16/MF A03

Lecture notes for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Unstructured Grid Methods for Advection Dominated Flow' have been assembled in this report. The objective of this course was to provide state of the art information, as well as recent developments in unstructured grid methods, suitable for the computation of high Reynolds number compressible and incompressible flows, and other related subjects. A wide range of applications is presented, which includes incompressible free surface problems, transonic aerodynamics, and hypersonic reentry flows.

N92-27672# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Mathematics.

FINITE ELEMENT METHODS FOR FLOW PROBLEMS

CLAES JOHNSON /in AGARD, Special Course on Unstructured Grid Methods for Advection Dominated Flows 47 p May 1992
Copyright Avail: CASI HC A03/MF A03

The purpose of this note is to give an overview of the Streamline

Diffusion Method (SDM), also referred to as Galerkin/Least Squares or Streamwise Upwind Petrov-Galerkin (SUPG), as a general finite element method for hyperbolic type differential equations modelling convection-diffusion, compressible/incompressible fluid flow or wave propagation. The SDM developed gives the first general solution to the fundamental problem of constructing finite element methods for hyperbolic problems with the desired combination of good stability and high accuracy. The SDM is a modified Galerkin method based on piecewise polynomial approximation with two modifications: a 'streamwise diffusion' modification of the test functions giving a weighted least squares control of the residual of the finite element solution; and the introduction of an artificial viscosity. Author

N92-27675# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). CFD Group.

MULTIDIMENSIONAL UPWIND METHODS FOR UNSTRUCTURED GRIDS

H. DECONINCK (CFC Products, Inc., Ann Arbor, MI.), R. STRUIJS (CFC Products, Inc., Ann Arbor, MI.), G. BOURGOIS (CFC Products, Inc., Ann Arbor, MI.), H. PAILLÈRE (CFC Products, Inc., Ann Arbor, MI.), and P. L. ROE (Michigan Univ., Ann Arbor.) In AGARD, Special Course on Unstructured Grid Methods for Advection Dominated Flows 17 p May 1992 (Contract AERO-0003-C)

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In this contribution we describe a class of upwind schemes for hyperbolic conservation laws on unstructured grids consisting of triangles or tetrahedrons. Unlike standard upwind schemes which are based on a one dimensional physical model (the Riemann problem), the methods discussed here use a multidimensional physical model for the upwinding. They do not fit in a standard finite volume approach with piecewise continuous representation of the unknowns. In this respect they are much closer to finite element methods based on linear elements, with which they share a continuous piecewise linear representation over the triangles or tetrahedrons. On the other hand they share with standard upwind methods the properties of asymmetric upwind stencils and control of monotonicity over discontinuities, and they can be considered as truly multidimensional generalizations of the successful TVD upwind methods developed during the eighties. Author

N92-27676*# University Coll. of Swansea (Wales). Dept. of Civil Engineering.

UNSTRUCTURED GRID METHODS FOR COMPRESSIBLE FLOWS

K. MORGAN (Swansea Tribology Centre (England).), J. PERAIRE (Swansea Tribology Centre (England).), and J. PEIRO (Imperial Coll. of Science and Technology, London, England) In AGARD, Special Course on Unstructured Grid Methods for Advection Dominated Flows 39 p May 1992 Sponsored in part by Dassault-Breguet Aviation and Rolls-Royce Ltd. (Contract NCCW-8; NAGW-478; NAGW-1809)

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The implementation of the finite element method on unstructured triangular grids is described and the development of centered finite element schemes for the solution of the compressible Euler equation on general triangular and tetrahedral grids is discussed. Explicit and implicit Lax-Wendroff type methods and a method based upon the use of explicit multistep timestepping are considered. In the latter case, the convergence behavior of the method is accelerated by the incorporation of a fully unstructured multigrid procedure. The advancing front method for generating unstructured grids of triangles and tetrahedra is described and the application of adaptive mesh techniques to both steady and transient flow analysis is illustrated. Author

N92-27678# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). CGD Group.

HIGHER ORDER UPWIND FINITE VOLUME SCHEMES WITH ENO-PROPERTIES FOR GENERAL UNSTRUCTURED MESHES

P. VANKEIRSBILCK and H. DECONINCK In AGARD, Special

Course on Unstructured Grid Methods for Advection Dominated Flows 54 p May 1992 Sponsored in part by Avions Marcel Dassault and Belgian National Fund for Scientific Research Copyright Avail: CASI HC A04/MF A03

This contribution presents high resolution upwind finite volume schemes based on a polynomial reconstruction of the unknowns on unstructured polygonal cells. The schemes are essentially non-oscillatory (ENO) through the use of an adaptive stencil selection. A complete analysis and comparison given in this text shows that the order of the space accuracy of the schemes is at least equal to the degree of the reconstruction polynomial. Numerical results are shown for a nonlinear hyperbolic conservation equation, confirming the ENO shock capturing and higher order accuracy on highly irregular grids. More realistic Euler calculations will demonstrate the ability of the concepts that are outlined theoretically. Author

N92-27680# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). CFD Group.

A FRONTAL APPROACH FOR NODE GENERATION IN DELAUNAY TRIANGULATIONS

J.-D. MUELLER (Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).), P. L. ROE (Michigan Univ., Ann Arbor.), and H. DECONINCK In AGARD, Special Course on Unstructured Grid Methods for Advection Dominated Flows 7 p May 1992

Copyright Avail: CASI HC A02/MF A03

A new algorithm for the generation of the interior nodes for Delaunay triangulation is given. The method uses a background grid to interpolate local mesh size parameters that are taken from the triangulation of the given boundary nodes. Geometric criteria are used to find a set of nodes in a frontal manner. This set is subsequently introduced into the existing mesh, thus providing an updated Delaunay triangulation. The procedure is completed when no more improvement of the grid by inserting new nodes can be achieved. Author

N92-28062# Exeter Univ. (England). Dept. of Mathematics.

INSTABILITY AND TRANSITION IN COMPRESSIBLE BOUNDARY LAYERS Final Report, 1 Nov. 1988 - 31 Oct. 1991

PHILIP HALL 31 Dec. 1991 14 p

(Contract AF-AFOSR-0042-89)

(AD-A248596; AFOSR-92-0214TR) Avail: CASI HC A03/MF A01

Results are presented for (1) Real gas effects and Gortler vortices, (2) Nonparallel effects on Gortler vortex growth of Sutherland Law fluids, (3) Secondary instability analysis of finite amplitude Gortler vortices at hypersonic speeds, (4) Effects of crossflow velocities on Gortler vortices, (5) Mode interactions in compressible flows, and (6) Receptivity theory for Gortler vortices. GRA

N92-28694# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

TURBULENCE MODELING: SURVEY OF ACTIVITIES IN BELGIUM AND THE NETHERLANDS, AND APPRAISAL OF THE STATUS AND A VIEW ON THE PROSPECTS

B. VANDERBERG 28 May 1990 12 p Presented at AGARD Fluid Dynamics Panel Technical Status Review on Appraisal of the Suitability of Turbulence Models in Flow Calculations, Friedrichshafen, Fed. Republic of Germany, 26 Apr. 1990 (NLR-TP-90184-U; ETN-92-91540) Avail: CASI HC A03/MF A01

Some experimental results obtained in turbulent boundary layers, as occur on airplane wings, are considered in relation to the usual turbulence mode assumptions. The status of turbulence modeling is found not to be satisfactory. To support the development of semiempirical models of acceptable accuracy, a more extensive base of reliable turbulence data is desirable. ESA

N92-28712# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics/Informatics Div.

BOUNDARY CONDITIONS FOR EULER EQUATIONS AT INTERNAL BLOCK FACES OF MULTI-BLOCK DOMAINS USING LOCAL GRID REFINEMENT

A. KASSIES (Aeritalia S.p.A., Naples (Italy).) and R. TOGNACCINI (Aeritalia S.p.A., Naples, Italy) 10 Apr. 1990 19 p Presented at the AIAA 21st Fluid Dynamics, Plasma Dynamics and Lasers Conference, Seattle, WA, 18-20 Jun. 1990 Previously announced in IAA as A90-38725 Prepared in cooperation with Aeritalia S.p.A., Naples, Italy

(Contract NIVR-01604-N)
(NLR-TP-90134-U; ETN-92-91533) Avail: CASI HC A03/MF A01

A method for the numerical treatment of boundary conditions for Euler equations at internal block faces of arbitrary complex three dimensional patched multiblock domains is developed. The method should allow cell length and skewness discontinuities of the grid normal to the internal faces, and local grid refinement in each block individually. The method is developed for multiblock flow solvers based on an explicit cell centered finite volume scheme with adaptive numerical dissipation. The discontinuities of the grid at internal block faces are treated by a boundary condition using the gradient vector of each flow variable to determine the flow state at the internal face. In case of local grid refinement, where a coarse grid cell may be connected to any number of fine grid cells, a unique value of the gradient vector is used for all fine grid cells connected to a coarse grid cell. The resulting scheme is fully conservative and may be easily extended to other types of flow solvers. By implementing the described method in a three dimensional multiblock solver, a powerful aerodynamic analysis tool for solving the Euler equations in an arbitrary flow domain is obtained. The ability of the flow solver to handle grid discontinuities over internal faces allows much freedom in the grid generation process. The use of local grid refinement per block offers the desired flow simulation accuracy with grids of reasonable size.

ESA

N92-28788# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de l'Aerodynamique.

CONSTRUCTION OF A NUMERICAL OPTIMIZATION METHOD FOR THE DEFINITION OF HYPERSUPPORTED PROFILES Final Summary Report [REALISATION DUNE METHODE DOPTIMISATION NUMERIQUE POUR LA DEFINITION DE PROFILES HYPERSUSTENTES. RAPPORT DE SYNTHESE FINAL]

F. MOENS Jun. 1991 66 p In FRENCH

(Contract DRET-89-34-001)

(ONERA-RSF-43/1736-AY-146A; ETN-92-91326) Avail: CASI HC A04/MF A01

The method for a two dimensional description of hyper-supported profiles by numerical optimization consists of a stress minimization program, named CONMIN, and the aerodynamic program, named VIS18. The viscous effects are taken into account by the strong coupling iterative method. The decision variables considered are the deflection values, slots and flap covers, and the incidence of the assembly. The aim of the study is to maximize the whole lift-slope coefficient, for given values of stresses of the overspeeds of different bodies. The importance of including the viscous effects was demonstrated for the optimization of the OALT25 laminar profile, with a two slit flap. The deflection values calculated are greater than those obtained by optimization in an inviscid fluid, and a separation on the second flap is observed. Problems concerning relative minimal values and of multiple solutions were found for the optimization of the OAULM02 profile, with a single slot flap. These effects can be reduced by increasing the coupling interactions, although the calculation time increases.

ESA

N92-29118# Oxford Univ. (England).

TURBULENT SPOT GENERATION AND GROWTH RATES IN A TRANSONIC BOUNDARY LAYER Final Report, 15 May 1989 - 14 Oct. 1991

J. P. CLARK, J. E. LEGRAFF, and T. V. JONES 18 Mar. 1992

24 p

(Contract AF-AFOSR-0427-89)

(AD-A250221; AFOSR-92-0365TR). Avail: CASI HC A03/MF A01

Wide-bandwidth surface heat transfer instrumentation has been used to track the generation, convection and growth of turbulent spots in a laminar boundary layer undergoing transition to turbulence. The model was a flat plate subjected to a range of free stream conditions in a piston-driven isentropic compression heated transient wind tunnel at Oxford University. Freestream Mach number (subsonic to 2.0), freestream turbulence and streamwise pressure gradient (favorable to adverse) were varied. Preliminary analysis of the time-resolved heat transfer data allowed estimates of spot convection rates, generation rates and spreading angles to be estimated. Convection rates were little affected by Mach number, whereas spreading angles were narrowed by favorable pressure gradients and expanded by adverse gradients. GRA

N92-29683# Manchester Univ. (England). Aeronautical Engineering Group.

AERONAUTICAL ENGINEERING GROUP PUBLICATIONS, 1950 - PRESENT

1989 19 p

(AERO-REPT-8907; ETN-92-91342) Avail: CASI HC A03/MF A01

A list of 232 publications of the aeronautical engineering group is presented. For each entry the author(s), source and date of publication, and article title, are presented. ESA

N92-29926# Technische Univ., Brunswick (Germany). Fakultät fuer Maschinenbau und Elektrotechnik.

EXPERIMENTAL EXAMINATION OF HEAVY LOADED AXIAL FANS WITH ROTATIONAL SYMMETRICAL DISTORTION OF THE INFLOW Ph.D. Thesis [EXPERIMENTELLE UNTERSUCHUNGEN HOCHBELASTETER AXIALVENTILATOREN BEI ROTATIONSSYMMETRISCHER STÖRUNG DER ZUSTRÖMUNG]

ROLAND KOERNER 1991 199 p In GERMAN

(ETN-92-91489) Avail: CASI HC A09/MF A03

The effects of rotational symmetrical inflow distortions on three aerodynamic heavy loaded bladings are experimentally examined with various design flow coefficients and various design pressure coefficients. It is shown that an additional overall pressure loss in the ventilator installation is related to the production of various flow profiles. The variation of velocity energy in the test levels zero and six, is to be taken into account for rotational symmetrical distortion of the flow. ESA

N92-29972# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

A FINITE VOLUME APPROACH TO LARGE EDDY SIMULATION OF COMPRESSIBLE, HOMOGENEOUS, ISOTROPIC, DECAYING TURBULENCE

A. W. VREMAN, B. J. GEURTS, J. G. M. KUERTEN, and P. J. ZANDBERGEN 28 Oct. 1991 28 p

(ISSN 0169-2690)

(MEMO-1009; ETN-92-91756) Avail: CASI HC A03/MF A01

Large eddy simulation (LES) of compressible, homogeneous, isotropic, decaying turbulence in a rectangular box is performed using finite volume techniques. Spectral analysis of the results of the simulations shows that an agreement with the Kolmogorov law for the inertial range can be reproduced only when an appropriate spatial discretization method is used. This agreement is obtained both for a low (0.05) and a moderate (0.6) Mach number when Smagorinsky's subgridmodel is employed. ESA

N92-29977# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

MONOPOLAR VORTICES AS RELATIVE EQUILIBRIA AND THEIR DISSIPATIVE DECAY

B. W. VANDEFLIERT and E. W. C. VANGROESEN Nov. 1991 26 p

(ISSN 0169-2690)

(MEMO-1015; ETN-92-91761) Avail: CASI HC A03/MF A01

Families of confined rotating monopolar vortices are characterized using a variational formulation with the angular momentum as the driving force for confinement. The characterization for positive monopolar vortices given, can be extended to negative vortices or to vortices within a rotating frame of reference. Besides the uniform Kirchhoff paths, new branches of vorticity solutions are found restricting the dynamics to levelsets of both the angular momentum and the quadratic anisotropy. The rotation rate of the smooth vorticity structures depends on the vorticity profile. This is made perceptible by considering both minimum energy vortices and minimizing vortices, rotating counterclockwise and clockwise respectively. An approximation for the decay of the vortices due to dissipation is given in terms of the dissipation of the integrals in the inviscid system. This description enables us to consider dissipation of vortices without loss of confinement. The elliptical Kirchhoff patches are found to symmetrize into circular patches. The minimum energy vortices gradually diminish while expending their support, while the maximum energy vortices are unstable for the dissipative evolution. ESA

N92-30023# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Thermal Engineering.

THE 2D-COMPUTATION OF AN AXIAL FAN WITH FINFLO

K. ERIKSSON 1992 16 p
(PB92-180678; REPT-68) Avail: CASI HC A03/MF A01

The flow pattern of an axial fan was simulated with a flow calculation program called FINFLO. The original program was modified. The modified version can handle internal two-dimensional viscous calculation. The modification concerning the boundary conditions is discussed. Author

N92-30372# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Information.

GLOBAL EXISTENCE FOR A SEMILINEAR ELLIPTIC-PARABOLIC PDE SYSTEM

SHUANHU LI 1991 17 p
(ISSN 0922-5641)
(REPT-91-70; ETN-92-91820) Copyright Avail: CASI HC A03/MF A01

An elliptic-parabolic PDE (Partial Differential Equation) system arising from a two dimensional groundwater flow problem is studied. It describes the mixing of fresh and salt water with dominant molecular diffusion. An approach based on $L(\sup p) - L(\sup q)$ a priori estimates for solutions and the inverse function theorem is used. Global existence and uniqueness are derived. ESA

N92-30453# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Information.

FLOW OF FRESH AND SALT WATER IN AN AQUIFER WITH INJECTION FROM THE TOP

PHILIPPE BLANC 1991 21 p Sponsored by Swiss National Science Foundation
(ISSN 0922-5641)
(REPT-91-68; ETN-92-91818) Copyright Avail: CASI HC A03/MF A01

A given Cauchy problem is studied in relation to the evolution in time of the interface between fresh and salt water flow. A model for the flow in a horizontal homogeneous aquifer of a given constant thickness is considered. The definition of a parabolic type problem is given and the uniqueness of its solution is proved. Two existence results are proved by parabolic regularization. ESA

N92-30454# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Information.

A MULTIGRID METHOD FOR A DISCRETIZATION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN GENERAL COORDINATES

C. W. OOSTERLEE and P. WESSELING 1991 12 p
(ISSN 0922-5641)
(REPT-91-73; ETN-92-91823) Copyright Avail: CASI HC A03/MF A01

A discretization for the incompressible Navier-Stokes equations

in general coordinates is derived. A staggered grid arrangement is used for the unknowns: contravariant flux components and pressure. The performance of the nonlinear multigrid algorithm, in particular the performance of two smoothing methods, Symmetric Coupled Gauss-Seidel (SCGS) and SCGS/Line Solver (LS), is investigated. ESA

N92-30649*# Politecnico di Torino (Italy).

A DYNAMIC SUBGRID-SCALE EDDY VISCOSITY MODEL

MASSIMO GERMANO, UGO PIOMELLI (Maryland Univ., College Park.), PARVIZ MOIN (Stanford Univ., CA.), and WILLIAM H. CABOT (Stanford Univ., CA.) In Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. 3: Proceedings of the 1990 Summer Program p 5-17 Dec. 1990
Avail: CASI HC A03/MF A03; 2 functional color pages

One major drawback of the eddy viscosity subgrid-scale stress models used in large-eddy simulations is their inability to represent correctly with a single universal constant different turbulent field in rotating or sheared flows, near solid walls, or in transitional regimes. In the present work, a new eddy viscosity model is presented which alleviates many of these drawbacks. The model coefficient is computed dynamically as the calculation progresses rather than input a priori. The model is based on an algebraic identity (Germano 1990) between the subgrid-scale stresses at two different filtered levels and the resolved turbulent stresses. The subgrid-scale stresses obtained using the proposed model vanish in laminar flow and at a solid boundary, and have the correct asymptotic behavior in the near-wall region of a turbulent boundary layer. The results of large-eddy simulations of transitional and turbulent channel flow that use the proposed model are in good agreement with the direct simulation data. Author

N92-30651*# Institut de Mecanique de Grenoble (France).

A SUBGRID-SCALE MODEL BASED ON THE SECOND-ORDER VELOCITY STRUCTURE FUNCTION

P. COMTE, SANGSAN LEE (Stanford Univ., CA.), and WILLIAM H. CABOT (Stanford Univ., CA.) In Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. 3: Proceedings of the 1990 Summer Program p 31-45 Dec. 1990
Avail: CASI HC A03/MF A03; 2 functional color pages

A series of tests were performed to help extend the use of a subgrid-scale model to compressible and wall-bounded flows. A priori tests were done in the case of the incompressible turbulent channel flow. They showed that a 1-D formulation of the structure-function model is more appropriate, leading to a satisfactory behavior of the model at the walls without requiring any damping function. This model is consistent with the original formulation of Metais & Lesieur (1990). In large-eddy simulations of compressible isotropic turbulence, both models performed well up to an initial rms Mach number of 0.6. Author

N92-30673*# Ecole Normale Supérieure, Paris (France).

CONTINUOUS WAVELET ANALYSIS OF COHERENT STRUCTURES

M. FARGE, Y. GUEZENNEC (Ohio State Univ., Columbus.), C. M. HO (University of Southern California, Los Angeles.), and C. MENEVEAU (Johns Hopkins Univ., Baltimore, MD.) In Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. 3: Proceedings of the 1990 Summer Program p 331-348 Dec. 1990

Avail: CASI HC A03/MF A03; 2 functional color pages

We perform an analysis of planar cuts through three dimensional turbulent fields (planar channel flow and mixing layer) using the 2D continuous wavelet transform. We propose two new diagnostics: (1) a measure of intermittency $I(r, \text{vector } x)$, which is the ratio of local energy and average energy at a given scale r ; and (2) a local Reynolds number, defined on the local velocity contribution at a given scale, computed from the wavelet transform of the three velocity components, the scale of the transform, and molecular viscosity; this gives a representation of the local non-linearity of the flow viewed in both space and scale. We find, for the analyzed flows, strong small-scale intermittency located in

the ejection regions for the channel flow and in the vortex core of the mixing layer. Author

N92-30674# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CALCULATION OF VISCOUS HYPERSONIC FLOWS IN CHEMICAL NON-EQUILIBRIUM

CHRISTIAN MUNDT Sep. 1991 14 p Presented at the 9th GAMM Conference on Numerical Methods in Fluid Mechanics, Lausanne, Switzerland, 25-27 Sep. 1991 (MBB/FE211/S/PUB/466; ETN-92-91905) Copyright Avail: CASI HC A03/MF A01

An efficient method which can calculate viscous flows at high Mach and moderate to high Reynolds numbers in chemical nonequilibrium by a solution of the Euler and second order boundary layer equations is presented. This approach is valid for flows showing no strong viscous/inviscid interaction. Thus it is suited for determining the flow at the windward side of reentry vehicles. Applications are discussed together with the modeling of effects of practical interest, such as catalytic walls and wall radiative equilibrium. ESA

N92-32725# Ecole Centrale de Lyon (France).

MODEL OF REYNOLDS STRESS ON NONORTHOGONAL GRID STRUCTURES: APPLICATION TO A STAGGERED TUBE BUNDLE Ph.D. Thesis [MODELE AUX TENSIONS DE REYNOLDS SUR MAILLAGES STRUCTURES

NON-ORTHOGONAUX: APPLICATION A UN ECOULEMENT DENS UN FAISCEAU DE TUBES EN QUINCONCE]

SAMUEL SEBAG 1991 185 p In FRENCH (ETN-92-91959) Avail: CASI HC A09/MF A02

The state of the art of models are reviewed. Developments in second order closing models are traced, highlighting their constraints, and an insight into new models whose complexity does not yet enable the generalization of wall flow is given. The adaptation of a numerical method, used for cartesian grids, to nonorthogonal grid structures, with the Gibson-Lauder Reynolds stress model, in the framework of ULYSSE-4 two dimensional finite volume code, is presented. K-epsilon and second order closing models are compared in the flow in a staggered bundle tube. The limits of the closure model, of the numerical approach, and of the limit conditions, are analyzed. ESA

N92-32765# Ecole Nationale d'Ingenieurs de Constructions Aeronautiques, Toulouse (France). Dept. de Mecanique des Fluides Aerodynamiques.

MASSIVELY SEPARATED FLOW MODELING. EXPERIMENTAL STUDY OF THE FINE STRUCTURE OF BOUNDARY LAYERS. STUDY OF THE INFLUENCE OF EXTERNAL TURBULENCE LEVEL Final Summary Report [MODELISATION D'ECOLEMENTS MASSIVEMENT DECOLLES. ETUDE EXPERIMENTALE DE LA STRUCTURE FINE DES COUCHES LIMITES. ETUDE DE L'INFLUENCE DU NIVEAU DE TURBULENCE EXTERIEURE. RAPPORT DE SYNTHESE FINAL]

J. B. CAZALBOU and P. CHASSAING 1991 26 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques (ETN-92-92088) Avail: CASI HC A03/MF A01

Wind tunnel tests to define methods and models for reliable prediction of separated flow around high incidence wing profiles, in turbulent boundary layer and incompressible flow conditions, are presented. The problem is examined in the context of first order modeling, with internal region processing based on the use of wall laws. The following are reported: the behavior of the first order model in the case of unfavorable pressure gradients; the validity of wall laws in separated regions; and the influence of external turbulence rates. ESA

N92-32767# Technische Univ., Munich (Germany). Inst. fuer Mathematik.

NUMERICAL SIMULATION OF TWO-DIMENSIONAL FLOWS BY THE FREE-LAGRANGIAN METHOD

MIKHAIL Y. SHASHKOV and ANDREY V. SOLOVJOV 1991 51 p Sponsored by German Research Society (TUM-M9105; ETN-92-92102) Copyright Avail: CASI HC A04/MF A01

The development, realization, and verification of a purely Lagrangian, conservative free-Lagrangian method are described. The term 'purely Lagrangian' means that the mass of particles is not changed; no mass, momentum, and energy exchange appears between particles; no interpolation or smoothing procedures are used; and the cell connected with a particle contains only one material (there are non-'mixed' cells). In the method, the network structure is determined by the Dirichlet tessellations of the computational domain. It is shown by a computational experiment that the volume of a Dirichlet cell varies more smoothly than that of comparable approaches when the structure of the grid changes. The continuity of the volume determines, for Lagrangian methods, the density continuity of the given particle. Another important property of the Dirichlet volume is that its derivatives, with respect to particle coordinates, are likewise continuous. These derivatives appear in the difference equations, so that acceleration, velocity, internal energy, and pressure are continuous. The conservative difference scheme is obtained by using the method of support operators. The approximation property of the constructed difference scheme is investigated. Some approaches to the treatment of free boundaries are described. Results of computation are presented for some two dimensional problems. ESA

N92-32770# Metraflu, Ecully (France).

PRESSURE FIELD DEVELOPED BY THE RANDOM MOVEMENT OF THE VORTICES NEAR A WALL Final Report [CHAMP DE PRESSION ENGENDRE PAR LE MOUVEMENT CHAOTIQUE DE TOURBILLONS AU VOISINAGE D'UNE PAROI. RAPPORT FINAL]

LUC COLLOREC and DANIEL JUVE Oct. 1991 71 p In FRENCH

(Contract DRET-90-1177A)

(ETN-92-91665) Avail: CASI HC A04/MF A01

The behavior of a linear ensemble of vortices, in a two dimensional non rotating fluid near a wall is modeled. The experimental results are presented and discussed. The initial motion of the vortices are characterized by Fourier transformation, by phase analysis and by Poincare section, for different initial vortex configurations. The existence of periodical or random regimes and order-disorder transition are highlighted. The pressure field at the wall is calculated during the passage of vortices. The configuration of the pressure distribution and of the somewhat chaotic motion of vortices were compared. The results revealed that the pressure oscillation frequency increases as the chaos increases. The directivity of the far acoustic field is shown to be quadrupolar and its intensity increases as the chaos increases. ESA

N92-32776# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction des Structures.

STRONG COUPLING BETWEEN INVISCID FLUID AND BOUNDARY LAYER OF SHARP LEADING EDGES: TWO-DIMENSIONAL STATIONARY AND TURBULENT CASES FOR ISOLATED PROFILES AND GUARD VANES [DOUPLAGE FORT FLUIDE PARFAIT COUCHE LIMITE POUR DES PROFILES A BORD D'ATTAQUE AIGU. CAS 2D STATIONNAIRE ET INSTATIONNAIRE POUR DES PROFILS ISOLEES ET POUR LES GRILLES D'AUBES]

C. SOIZE Dec. 1991 75 p In FRENCH

(Contract DRET-89-34-001)

(ONERA-RT-44/1621-RY-016-R; ETN-92-91675) Avail: CASI HC A04/MF A01

The theory and the numerical model concerning the strong coupling between the inviscid fluid and the upper boundary layer are presented. The calculations are performed for two dimensional turbulent and stationary conditions. The results were compared to those obtained from wind tunnel tests, and a good agreement between them is obtained. A quasi-stationary simplified method to approximately calculate, at low costs, the turbulent aerodynamic forces for guard vanes, is given. ESA

N92-32835# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

CFD EFFORTS IN THE NETHERLANDS

W. LOEVE 4 Jul. 1991 14 p Presented at the 4th International Symposium on CFD, Davis, CA, 9-12 Sep. 1991
(NL-TP-91250-U; ETN-92-92006) Avail: CASI HC A03/MF A01

Research in the Netherlands on technical and organizational methods, techniques, and tools to structure and integrate the growing amount of CFD (Computational Fluid Dynamics) software and supporting utility programs, is reviewed. This has resulted in ISNaS, an open software system for development, production, and application of CFD. The system is implemented on a powerful local network connected to the national network. The approach is described for cooperative development of CFD software that can form part of an open system such as ISNaS. Reference is made to application of the approach for solvers for the Reynolds averaged Navier-Stokes equations concerning three cooperative development projects. ESA

N92-32856 British Petroleum Co. Ltd., London (England).

SPRAY NOZZLE FOR FIRE CONTROL Patent Application

PANAYIOTIS G. PAPAVERGOS, inventor 14 Sep. 1990 15 p
(CA-PATENT-APPL-SN-2-011-945;
INT-PATENT-CLASS-B05B-1/00; CTN-92-60391) Avail:
Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville,
Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada
HC/MF

The design of a spray nozzle for fire control is described. It produces a spray of gas and liquid having an oval transverse cross section and it comprises a mixing chamber with an oval transverse cross section adapted to induce a toroidal mixing pattern in pressurized gas and liquid introduced to the mixing chamber through a plurality of inlets. In a preferred embodiment the mixing chamber is toroidal. The spray nozzle produces an oval spray pattern for more efficient wetting of narrow passages and is suitable for fire control systems in vehicles or other confined spaces. Vehicles to which this invention may be applied include trains, armoured vehicles, ships, hovercraft, submarines, oil rigs, and most preferably, aircraft. CISTI

N92-33910# Universitaet der Bundeswehr, Hamburg (Germany). Fachbereich Maschinenbau.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF UNIFORMLY AND UNEQUALLY SPACED TURBINE CASCADES Ph.D. Thesis [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN AN GLEICHFOERMIG UND UNGLEICHFOERMIG GETEILTEN TURBINENGITTERN]

RAINER KURZ 1991 175 p In GERMAN
(ETN-92-92056) Avail: CASI HC A08/MF A02

Experimental flow measurements and theoretical computations were carried out. A laser two focus system was used for flow examination. Computation was in good agreement with experimental data. A Euler process was used for the calculations. Experiment and computation showed lower losses for the transonic flow than for the subsonic flow, as long as shock collisions were kept small. A computation process was developed for the exact calculation of subsonic, transonic and sonic flow, for any inequally spaced configuration. It was concluded from computation and measurements, that the interactions between the blades with unequal spacing can be described by the frictionless computation. ESA

N92-33916# Ruhr Univ., Bochum (Germany). Fakultae fuer Maschinenbau.

INFLUENCE OF THE SWIRL PRODUCING CONSTRUCTION IN THE FLOW AND REACTION FIELD OF TURBULENT DIFFUSION FLAMES Ph.D. Thesis [UEBER DEN EINFLUSS DER DRALLERZEUGERKONSTRUKTION AUF DAS STROEMUNGS- UND REAKTIONSFELD TURBULENTER DIFFUSIONSFLAMMEN]

BERNHARD MUNDUS 1990 181 p In GERMAN
(ETN-92-92103) Avail: CASI HC A09/MF A02

Data relating to the influences of single constructions on the

aerodynamic properties of turbulent free jet and on the flow and reaction field of free burning turbulent diffusion flames were experimentally obtained and compared. The theoretical swirl number and the swirl number obtained from measuring data were used to describe the swirl power. It was shown that radial positions, and the rates of maximum turbulence degree depend on the swirl producing construction and on the swirl power. Swirl jets and flames were modeled using an integral process based on the analogy between unstationary heat conduction and impulse spreading for free turbulent flows. ESA

N92-33996# European Space Agency, Paris (France).

EXPERIMENTAL INVESTIGATION OF CROSS-FLOW INSTABILITY IN THE LINEAR AND NON-LINEAR STAGE OF THE TRANSITION REGION Ph.D. Thesis - Karlsruhe Univ. [EXPERIMENTELLE UNTERSUCHUNG DER QUERSTROEMUNGSINSTABILITAET IM LINEAREN UND NICHTLINEAREN BEREICH DES TRANSITIONSGEBIETES]

BERNHARD MUELLER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Mar. 1992 154 p
Transl. into ENGLISH of Experimentelle Untersuchung der Querstroemungsinstabilitaet im Linearen und Nichtlinearen Bereich des Transitionsgebietes (Goettingen, Fed. Republic of Germany, DLR), Feb. 1990 115 p Original language document was announced as N91-12057

(ESA-TT-1237; DLR-FB-90-09; ETN-92-91963) Avail: CASI HC A08/MF A02; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

A study on linear and nonlinear stages of the laminar turbulent transition process in three dimensional boundary layers, which are dominated by crossflow instability, using, in particular, hot wire anemometry, is presented. The experimental model used is closely matched to the assumptions and simplifications made in linear and secondary stability theory, as well as those made in the numerical simulation. The instability modes are studied with respect to wavelength, frequency range, characteristic profile and amplification. The modes display nonlinear saturation in these experiments. At the same time, strong nonlinear interactions are observed between the stationary vortices and traveling waves over the whole of the parameter domain investigated. Furthermore, the modes depend strongly on initial conditions with respect to their amplitudes, wavelengths, frequency ranges and amplification rates. Variations of sweep angle and incident velocity display the trends predicted by linear stability theory although nonlinear effects continue to dominate. ESA

N92-34038 Council for National Academic Awards (England).

FINITE ELEMENT SIMULATION OF VISCOELASTIC FLOW Ph.D. Thesis

SEAN JAMES SWARBRICK 1990 196 p
Avail: Univ. Microfilms Order No. BRDX93642

A new finite element algorithm for the solution of viscoelastic flow problems is presented. The algorithm uses a decoupled iterative scheme, with element subdivision for the stress field approximations. The viscoelastic fluid models used are differential models of the Maxwell/Oldroyd type. The problem of convergence failure of the iterative scheme is addressed. A number of techniques for increasing the range of convergence are investigated. These include streamline upwinding, variational recovery of velocity gradients, and an interpolation method for the stress field approximation. The effects of these techniques on the non-iterative solutions of the upper-convected Maxwell constitutive equations are also studied. In addition, the convergence properties of the decoupled iterative scheme are investigated. These various investigations are carried out in the context of three particular test problems: the straight parallel-sided channel, the planar abrupt 4:1 contraction, and a 30 degree converging channel. A number of auxiliary programs required for finite element simulations were also developed. These include programs for mesh generation, graphic display, and preparation of numerical integration data. It was demonstrated that useful results in finite element simulation can be obtained even when the available computing resources are very limited. Dissert. Abstr.

N92-70151 Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics.

EXOTIC STATES IN THE CORES OF QUANTIZED VORTICES FOR SUPERFLUIDS AND SUPERCONDUCTORS

M. M. SALOMAA (Helsinki Univ. (Finland).) and G. E. VOLOVİK (Landau Inst. for Theoretical Physics, Moscow, USSR) 1988 34 p (DE92-728466; TKK-F-A629) Avail: CASI HC A03/MF A01

We consider the core structures of quantized vortex lines in Bose and Fermi superfluid systems. We emphasize the result that within the core of a singly quantized vortex line in a Bose superfluid, there spontaneously appears to be a condensate of boson pairs in a relative d-wave state, instead of the normal fluid. Also in the case of the singly quantized Abrikosov vortex line in a superconductor instead of normal electrons, there emerges a novel state of superconductivity in which a condensate of bosons made of four fermions appears. In particular, we discuss these core structures as further examples for the flaring-out of the vortex singularity into higher dimensions, in analogy with the extended-space topology of the superfluid He-3-B vortex core; we also relate this generic behavior to the Laughlin state within the quantum Hall effect (QHE). DOE

N92-70561 National Aerospace Lab., Amsterdam (Netherlands). COMPUTATION OF UNSTEADY TRANSONIC BOUNDARY LAYER EFFECTS ON UNSTEADY FLOW ABOUT AIRFOILS

R. HOUWINK 3 Jan. 1989 15 p Presented at the 4th Symposium on Numerical and Physical Aspects of Aerodynamic Flows, Long Beach, CA, 16-19 Jan. 1989 Sponsored by Netherlands Agency for Aerospace Programs (PB92-138569; NLR-TP-89003-U) Avail: CASI HC A03/MF A01

An outline is given of a computer code for the prediction of unsteady two-dimensional viscous flows about airfoils. The code, named ULTRAN-V, is based on unsteady transonic small perturbation theory, coupled in strong interaction with a new unsteady version of Green's lag-entrainment method for a turbulent boundary layer. The unsteady modeling of the boundary layer is evaluated by comparison with results of other theories for incompressible boundary layer test cases. The applicability of the coupled viscous-inviscid method is analyzed for the NACA64A006 airfoil with oscillating flap at a range of transonic flow conditions, by comparison with experimental data. Also, the effects of the unsteady boundary layer modeling and of a fully time-accurate coupling procedure are investigated. Author

35

INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

A92-16077

POINT MEASUREMENT OF SURFACE TEMPERATURE IN A HYPERSONIC WIND TUNNEL USING PHOTOLUMINESCENCE [MESURE PONCTUELLE DE TEMPERATURE DE SURFACE EN SOUFFLERIE HYPERSONIQUE PAR PHOTOLUMINESCENCE]

P. BAUMANN (ONERA, Chatillon, France) (OPTO '91, Congres, Paris, France, Mar. 26-28, 1991) ONERA, TP no. 1991-94, 1991, 10 p. In French. Research supported by DRET. refs (ONERA, TP NO. 1991-94)

A photoluminescence-based methodology for point measurements of surface temperature in hypersonic wind tunnels is described with reference to the evaluation of heat-flux distributions on aerospace vehicles. Properties of the heat-sensitive photoluminescent composition chosen for the experiments (a Eu-ion-doped rare-earth-O₂S compound) are discussed, and the point-measurement facility is described. In addition, the heat-measurement potential of rare-earth-oxygen-sulfur composi-

tions is evaluated, and first results of hypersonic wind tunnel tests are presented. L. M.

A92-16124

AEROSOL BEHAVIOR IN SUPERSONIC FLOWS

C. D'HUMIERES, F. MICHELI, and O. PAPIRNYK (ONERA, Chatillon, France) (International Conference on Laser Anemometry, 4th, Cleveland, OH, Aug. 5-9, 1991) ONERA, TP no. 1991-155, 1991, 12 p. refs (ONERA, TP NO. 1991-155)

The responses of aerosols for laser Doppler velocimetry to the velocity step are classified based on the results of experimental study of oblique shock-wave crossing in a wind tunnel. Several seeding techniques are discussed in terms of size and density, and an aerosol is chosen based on lag coefficient and experimental conditions. Four acceptable aerosols are identified, and a Mach-3 helium nozzle permits the selection of the aerosols and the validation of the laser Doppler velocimetry. C.C.S.

A92-20996

HIGH PERFORMANCE CAPILLARY ELECTROPHORESIS IN MICROGRAVITY ENVIRONMENT

F. ECKHARD (Comprimio, Amsterdam, Netherlands) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 247-255. Research supported by Netherlands Agency for Aerospace Programs. refs Copyright

Capillary electrophoresis is developing into an accurate analysis technique. With micellar techniques even uncharged particles can be analyzed. The field of capillary electrophoresis is broad and shows an overlap with HPLC. The equipment for capillary electrophoresis is very compact, low in weight, energy consumption, and waste production. Author

A92-21450

MEASUREMENT OF CONVECTIVE HEAT-TRANSFER COEFFICIENTS ON A WIND TUNNEL MODEL BY PASSIVE AND STIMULATED INFRARED THERMOGRAPHY

D. L. BALAGEAS, D. M. BOSCHER, and A. A. DEOM (ONERA, Chatillon, France) IN: Infrared technology XVI; Proceedings of the Meeting, San Diego, CA, July 11-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 339-357. Research supported by DRET and Matra, S.A. refs Copyright

Research conducted at ONERA to make quantitative infrared thermography operational and applicable to any 3D model is discussed. The problems of precise thermometry using this technique are considered, and the methodological and hardware choices made to obtain quantitative thermograms are described. The problem of determining the convective flows once the unsteady temperatures are known is addressed for two kinds of methods: classical passive thermography, in which only the heating due to convection is used, and active, or stimulated, thermography, in which the heat-transfer coefficients are calculated directly from the additional heating of the model by a radiation source, applied for short periods during the test. C.D.

A92-37159

AIRCRAFT EXPERIMENTS WITH VISIBLE AND INFRARED SENSORS

A. WADSWORTH (Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse; Institut Francais du Pétrole, Rueil-Malmaison, France), W. J. LOOYEN (Nationaal Lucht- en Ruimtevaartlaboratorium, Emmeloord, Netherlands), R. REUTER (Oldenburg, Universitaet, Federal Republic of Germany), and M. PETIT (Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Montpellier, France) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, no. 6-7,

Apr.-May 10, 1992, p. 1175-1199. refs
Copyright

This paper describes briefly the first-generation of visible and near-visible sensors and how they were used in airborne experiments, explains the developments being conducted from mechanical to push-broom scanners and to non-scanning sensors, shows how some sensors were being integrated in comprehensive systems, and what is the trend found in the later years of the period of reference. This is illustrated by examples of existing equipment in France and in Europe, and two case studies: one on the Dutch CAESAR push-broom scanner, the other on the Oceanographic Lidar System developed by the University of Oldenburg in Germany. Author

A92-44327

INSTANTANEOUS VISUALIZATION OF SURFACE FLOWS

J. TENSI (Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers, France) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 1, May 1992, p. 33-36. refs
Copyright

Two negative ion classes, namely NO_3^- and HNO_3 , and HSO_4^- and H_2SO_4 , were identified in the stratosphere, and from these ions neutral HNO_3 and H_2SO_4 in the gas phase were determined. A technique is proposed which makes it possible to detect a series of trace gas species in the middle atmosphere with a one-km height resolution from the ion composition. This technique is considered to be promising for the study of heterogeneous chemical reactions on aerosols and gas phase variations during evaporation and condensation. O.G.

A92-45129

INSTANTANEOUS MEASUREMENT OF DENSITY FROM DOUBLE SIMULTANEOUS INTERFEROGRAMS

JEAN-MICHEL DESSE and JEAN-CLAUDE PEGNEAUX (ONERA, Institut de Mécanique des Fluides, Lille, France) IN: International Congress on High-Speed Photography and Photonics, 19th, Cambridge, England, Sept. 16-21, 1990, Proceedings. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 766-774. Research supported by DRET. refs
Copyright

The visualization technique presented herein is based on white light differential interferometry using large Wollaston biprisms. The particularity of the set-up is that it yields two instantaneous interferograms, taken at precisely the same time, on which the interference fringes are differently oriented. Thus, the instantaneous fields of two different partial derivatives of density are simultaneously recorded and it is possible, through the use of both, to obtain the value of the density in domains where this can not be done using a single interferogram. This method has been successfully tested in the two-dimensional unsteady flow past a cylinder. Author

A92-45136

A LASER LIGHT SHEET INVESTIGATION INTO TRANSONIC EXTERNAL AERODYNAMICS

C. E. TOWERS, D. P. TOWERS, T. R. JUDGE, and P. J. BRYANSTON-CROSS (Warwick, University, Coventry, England) IN: International Congress on High-Speed Photography and Photonics, 19th, Cambridge, England, Sept. 16-21, 1990, Proceedings. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 952-965. refs
Copyright

The present light sheet system for 3D studies of the location and structure of transonic flows employs a CCD video camera and digital frame-store which are synchronized with the pulsed laser so that the resulting images can be immediately displayed via microcomputer. These video images are digitally enhanced in order to display 3D coordinate data. An illustrative demonstration of the system is for rotating transonic-jet flow. The visualized images show instantaneous transonic flow structures. O.C.

A92-48607

INDIRECT MEASUREMENTS OF CONVECTIVE FLOW BY IR THERMOGRAPHY [MESURES INDIRECTES DE FLUX CONVECTIFS PAR THERMOGRAPHIE INFRAROUGE]

A. RISTORI, J. GUERNIGOU, and J. PERUCCHINI (ONERA, Chatillon, France) (Société Française des Thermiciens, Journée d'Etude sur les Problèmes Radiatifs dans les Domaines Aéronautiques et Spatiaux, Paris, France, Apr. 1, 1992) ONERA, TP no. 1992-46, 1992, 12 p. In French. Research supported by DRET. refs
(ONERA, TP NO. 1992-46)

ONERA has conducted an experimental study of the effect of buffers on heat transfer by internal convection. This study is performed with the DELPHES test facility. The heat transfer coefficients are determined by identification of thermocouple measurements and transient IR thermography measurements with theoretical results calculated from a finite-element thermal code. These experiments are also used to evaluate heat flux measurement techniques and to validate codes for fluid-mechanical calculation. R.E.P.

A92-49773

INTERPRETATION OF FIELD MEASUREMENTS MADE WITH A PORTABLE ALBEDOMETER

J. C. H. VAN DER HAGE (Utrecht State University, Netherlands) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 9, no. 4, Aug. 1992, p. 420-425. refs
Copyright

The use of a hand-held albedometer over nonuniform surfaces is discussed in general and for the theoretical case of perfect spectral and cosine responses. The albedometer is described emphasizing its sensor sensitivity and specifications for spectral and cosine responses, and attention is given to the procedures for trimming and testing the instrument and to errors introduced by the observer and tilting the instrument. The interpretation of measured albedo values is described focusing on the smoothing of local albedo variations by integration over the 180-deg aperture. The resolution of the albedometer agrees with the calculated values to within 10 percent, and the portable instrument provides better resolution than readings from aircraft. The minimum size of a contrasting patch is determined, and the present albedometer is shown to offer advantages over other techniques. C.C.S.

A92-50037

A HOT WIRE METHOD FOR MEASURING TURBULENCE IN TRANSONIC OR SUPERSONIC HEATED FLOWS

P. DUPONT and J. F. DEBIEVE (Institut de Mécanique Statistique de la Turbulence, Marseille, France) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 2-3, 1992, p. 84-90. refs
Copyright

This work presents a method for measuring fluctuating quantities such as temperature or velocity using a constant current hot wire anemometer. The scope of this method has been extended to include not only supersonic flows, but also transonic flows with low Reynolds numbers and transonic or supersonic heated flows. After examining the dependence of the different coefficients of sensitivity to aerodynamic and thermal parameters, the result of the study was applied to a turbulent boundary layer using a suitable processing method. Author

A92-51630

A LARGE FORMAT FILM CAMERA FOR HIGH PRECISION OBJECT RECORDING

JUERGEN DOLD (Braunschweig, Technische Universität, Germany) IN: Close-range photogrammetry meets machine vision; Proceedings of the Meeting, Zurich, Switzerland, Sept. 3-7, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 252-255. refs
Copyright

The present large format camera (LFC) is microprocessor-controlled, and employs a rigorous reseau technique to define the image space with a degree of geometric accuracy and reliability that renders it useful in close-range industrial

photogrammetry. The LFC's image format is 226 x 226 mm; its microprocessor control allows not only simple and fast handling, but also remote control and the synchronization of several cameras. An illustrative application of this camera is in quality control during the production of Airbus aircraft. O.C.

A92-52370

OPTICAL MICROMACHINED PRESSURE SENSOR FOR AEROSPACE APPLICATIONS

DIOGENES ANGELIDIS and PHILIP PARSONS (Schlumberger Industries, Transducer Div., Farnborough, United Kingdom) Optical Engineering (ISSN 0091-3286), vol. 31, no. 8, Aug. 1992, p. 1638-1642. refs

Copyright

An optical pressure sensor has been designed using silicon micromachining technology. A resonant silicon beam is mounted above a diaphragm and its resonant frequency changes with applied pressure. The sensor is temperature compensated by way of a second pressure-insensitive resonator. Both resonators are optically addressed via the same optical fiber. The sensor is designed to give an overall accuracy of 0.5 percent full-scale pressure, which is currently between 130 kPa or 3 MPa. Optical technology allows the optical pressure sensor to operate in a harsh aerospace environment where electronic pressure sensors cannot survive. Author

A92-54302

INVESTIGATION ON OPTIMIZING THE DESIGN PROCESS OF MULTI-HOLE PRESSURE PROBES FOR TRANSONIC FLOW WITH PANEL METHODS

TH. DEPOLT and W. KOSCHEL (Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1-9. refs

Copyright

Recent developments made at the Institute of Jet Propulsion and Turbomachinery of the Technical University of Aachen on the topic of miniaturized multihole pressure probes to be utilized in transonic turbine flows are presented. The main emphasis is on the numerical description of the flow around the probe head. A very efficient tool, the panel method, was used to calculate the pressure distribution on the surface. By the aid of this method the design process of a pneumatic multihole pressure probe can be supported. The influence of some geometry variations on the flow around the probe head is investigated, and the probe coefficients are presented and discussed. I.E.

A92-54303

A NEW OPTICAL PRESSURE MEASUREMENT SYSTEM (OPMS)

ARNE VOLLAN (Omega GmbH, Grafrath, Germany) and LORETO ALATI (Inteco, Frosinone, Italy) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 10-16.

Copyright

The OPMS allows the measurement of pressure distribution over the whole surface of a wind tunnel model without pressure orifices, tubing and wiring. The model is simply coated with luminescence intensity pressure sensor paint which is illuminated by a laser light source. Due to the oxygen quenching of the molecules in the active paint layer, the intensity of the emitted light from the model surface differs according to the different pressures acting on the surface. The emitted light is then recorded by means of a sensitive charge-coupled-device (CCD) camera which transmits the detected information to a processing unit, allowing reconstruction of the pressure distribution. I.E.

A92-54304

AERODYNAMIC ASSESSMENT OF AN OPTICAL PRESSURE MEASUREMENT SYSTEM (OPMS) BY COMPARISON WITH CONVENTIONAL PRESSURE MEASUREMENTS IN A HIGH SPEED WIND TUNNEL

R. H. ENGLER, K. HARTMANN (DLR, Goettingen, Germany), and B. SCHULZE (MBB GmbH, Ottobrunn, Germany) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 17-24. refs

Copyright

The authors present an assessment of a novel optical pressure measurement system (OPMS). For this purpose experiments were carried out in a high-speed wind tunnel on a cropped delta wing model to demonstrate and assess this technique. Pressure distributions were measured separately as well as simultaneously with both the OPMS and a conventional technique via pressure taps for comparison. Temperature variations on the model surface were determined by means of an infrared camera and thermocouples to assess a possible error caused by temperature changes. Surface oil flow visualizations were performed to get additional information on boundary layer transition, separation, and reattachment lines as well as vortex positions. I.E.

A92-54321

QUANTITATIVE HEAT TRANSFER MEASUREMENTS IN HYPERSONIC WIND TUNNELS BY MEANS OF INFRARED THERMOGRAPHY

G. SIMEONIDES, J. P. VERMEULEN, H. L. BOERRIGTER, and J. F. WENDT (Von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese, Belgium) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 178-189. refs

Copyright

A description of infrared thermography as this is employed in a hypersonic blowdown wind tunnel for the acquisition of high quality '2-D' heat transfer data over aerodynamic surfaces is given. It is shown that the availability of an infrared scanning radiometer and a standard digital image processing system in the laboratory may provide the means for the performance of highly efficient (in terms of time and cost) heat transfer measurements, which exhibit accuracy levels comparable to those achieved by classical discrete point gauges such as thin film surface resistance thermometers and thermocouples. Author

A92-54337

PARTICLE IMAGE VELOCIMETRY MEASUREMENTS OF THE AERODYNAMICS OF A WIND TURBINE

I. GRANT, G. H. SMITH, A. LIU (Heriot-Watt University, Edinburgh, United Kingdom), D. INFELD (Rutherford Appleton Laboratory, Didcot, United Kingdom), and T. EICH (Universitaet Essen-Gesamthochschule, Germany) IN: ICIASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 314-320. refs

Copyright

The authors describe an aerodynamic study of flow over a simple commercial wind turbine in wind tunnel experiments using the particle image velocity (PIV) technique. In particular the use of the PIV technique was demonstrated for determining both the characteristics of the tip vortices trailing from consecutive blades of the wind turbine and circulation around the individual blade. These factors are of interest to both helicopter and wind turbine blade design. The experimental apparatus is described as it pertains to the sampling of the periodic but unsteady flow found behind the rotor. Also described are the data processing techniques used to extract velocity, vorticity and circulation measurements from the PIV images. I.E.

A92-54339

SPECTRAL ANALYSIS WITH A LDA IN HIGH SPEED FLOW

P. DUPONT (DLR, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, Germany) IN: ICASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 329-335. refs

Copyright

Spectral analysis of velocity measurements in turbulent flow acquired with a laser Doppler anemometer (LDA) is studied. The problems of seeding and signal analysis are discussed. In order to define the limits of such an analysis, especially in the case of high speed flow, tests with simulated signals and real experiments in low and higher speeds have been carried out. The possibility of passing the Nyquist limit by using a random sampling scheme is discussed. Results obtained in the wake of a cylinder are presented. I.E.

A92-56826#

APPLICATION OF ELECTRONICALLY SCANNED PRESSURE MEASUREMENT SYSTEM FOR ENGINE SIMULATION TESTS IN THE GERMAN-DUTCH WIND TUNNEL

J. W. KOOI (DNW German-Dutch Wind Tunnel, Emmeloord, Netherlands), W. BURGSMUELLER (Deutsche Airbus GmbH, Bremen, Germany), G. H. HEGEN, and J. F. SLAUERHOFF (National Aerospace Laboratory, Emmeloord, Netherlands) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 18 p. refs (AIAA PAPER 92-4003) Copyright

The accuracy of an electronic scanning system is assessed for the calibration of turbofan powered simulators (TPS) with mechanical and electronic systems measuring in parallel. Pressure and temperature fluctuations were investigated. The test data was analyzed using the measurement uncertainty methodology applied for full-scale gas-turbine testing. This method was also used to calculate the propagation of TPS calibration and pressure measurement errors to the wind-tunnel results. It was found that the accuracy of mechanical and electronic results is comparable. The electronic scanning system has a much higher scanning rate and it is expected that the wind-tunnel test time can be reduced by about 10 to 20 percent or equivalent increases in data rates.

Author

N92-10534# Tampere Univ. of Technology (Finland). Dept. of Physics.

LOW PRESSURE IMPACTOR WITH ELECTRICAL CONCENTRATION DETECTION Abstract Only

J. KESKINEN and KIMMO PIETARINEN /in Oulu Univ., Proceedings of the 25th Annual Conference of the Finnish Physical Society 1 p 1991

Avail: CASI HC A01/MF A03

To achieve automatic operation, the Quartz Crystal Microbalance (QCM) technique was applied to the measurement of collected mass. The sensitivity of QCM is good for large particles but rather poor for submicrometer particles. Inertial impactors are widely used devices for the measurement of aerosol particle size distribution and concentration, partly because of their large size range. The concepts of electrical detection with aerodynamic sizing is extended to submicrometer particles. For size classification, a modified commercial low pressure impactor is used. The lowest cutoff size of the device is 15 nm. A multichannel electrometer was constructed using low cost monolithic electrometer op amps. The main problem of using these circuits is the input bias current and its sensitivity to temperature variations. This problem was solved using automatic zeroing. As a result, input current an order of magnitude smaller than the bias current can be measured. The instrument combines aerodynamics size classification of particles with good sensitivity for submicrometer particles and automatic operation. Preliminary results of a study are presented. ESA

N92-15004# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Div. de Thermophysique.

ABLATION AND TEMPERATURE SENSORS FOR FLIGHT MEASUREMENTS IN REENTRY BODY HEAT SHIELDS

J. J. CASSAING, D. L. BALAGEAS, A. A. DEOM, and J. C. LESTEL /in ESA, Aerothermodynamics for Space Vehicles p 241-246 Jul. 1991 Sponsored in part by CEA and Aerospatiale

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Since 1977, Onera has ground and flight tested different techniques for heat shield recession: acoustic and combined temperature/ablation optical measurements. This last technique uses a gage that views the radiation optically from a cavity embedded within the heat shield. Flight measurements, both of temperature and of passage of the ablation front are compared with data generated by a predictive numerical code. The ablation and the heat diffusion into the instrumented ablator can be simulated numerically to evaluate accurately the errors due to the presence of the gage. The ablation measurement alone of the reentry body nose is made by an acoustic gage. The temperature measurement alone of the heatshield inner wall will be soon carried out by an optical sensor. ESA

N92-17344# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).

DEVELOPMENT OF AN ELECTRONIC HIGH SPEED CAMERA SYSTEM FOR THE QUANTITATIVE ANALYSIS OF UNSTEADY FLOWS

BERNWARD BRETTTHAUER 1991 75 p In GERMAN; ENGLISH summary (ISSN 0374-1257)

(MPIS-100/1991; ETN-92-90624) Avail: CASI HC A04/MF A01

A high speed camera system, based on eight CCD cameras and the Cranz-Scharlin principle, was developed for the quantitative analysis of unsteady flows. Light emitting diodes were used for illumination. Interferograms were taken from experiments concerned with vortex airfoil interaction, showing the generation of local stagnation points by this interaction. The camera generates high quality pictures suitable for quantitative analysis using an image processing system which was improved for this purpose. The system allows the recognition of weak compression waves. ESA

N92-24363# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany).

DEVELOPMENT OF A SUBMILLIMETER/FAR INFRARED HETERODYNE SPECTROMETER: TESTING ON SPACECRAFT AS A PREPARATION FOR THE FIRST PROJECT

[ENTWICKLUNG EINES SUBMM/FIR-HETERODYN-SPEKTROMETERS; ERPROBUNG MIT ASTROFLUGZEUGEN ZUR VORBEREITUNG AUF FIRST]

P. G. METZGER /in Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 41-42 Dec. 1990 In GERMAN Avail: CASI HC A01/MF A02

A heterodyne spectrometer for the wavelength region between 100 and 500 microns was developed as preparation for the FIRST (Far Infrared and Submillimeter Space Telescope) project. Since no low noise amplifiers exist in this region, the incoming signal is mixed down to a microwave frequency and then spectrally analyzed in an acousto-optical spectrometer. The heterodyne spectrometer was used on the KAO (Kuiper Airborne Observatory) of NASA for the observation of the Orion nebula. ESA

N92-25602# Deutsche System-Technik G.m.b.H., Bremen (Germany).

TESTING OF AN EXPERIMENTAL PHOTOGRAPHIC RECONNAISSANCE SYSTEM [ERPROBUNG EINES EXPERIMENTALSYSTEMS ZUR BILDAUFKLAERUNG]

H. KEIL (Deutsche System-Technik G.m.b.H., Bremen (Germany, F.R.)) and P. SCHULZ (Deutsche Forschungsanstalt fuer Luft-

und Raumfahrt, Brunswick, Germany, F.R.) *In* DLR, Flight Test of Avionic and Air-Traffic Control Systems p 233-246 Jul. 1991 *In* GERMAN

Avail: CASI HC A03/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

A scientific flight experiment system for image processing and disturbance safe image transmission was tested, with a view to a Remotely Piloted Vehicle application. The special features of the system are IR image representation and storage, evaluation in the ground station, systems and image sensor control from the ground station, and disturbance safe duplex radio transmission between test aircraft and ground station. This experimental system was demonstrated to be an excellent tool for studies in the field of disturbance safe photographic reconnaissance. Parameters such as the reduction factor of the information flow and the influence of perturbations can be determined. ESA

N92-29326*# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

DIODE-PUMPED ND:YAG LIDAR FOR AIRBORNE CLOUD MEASUREMENTS

A. MEHNERT, TH. HALLDORSSON, H. HERRMANN (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), R. HAERING (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), W. KRICHBAUMER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), J. STREICHER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), and CH. WERNER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) *In* NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 369-371 Jul. 1992

Avail: CASI HC A01/MF A04

This work is concerned with the experimental method used to separate scattering and to use it for the determination of cloud microphysical parameters. It is also the first airborne test of a lidar version related to the ATLID Program - ESA's scheduled spaceborne lidar. The already tested DLR microlidar was modified with the new diode-pumped laser and a faster data recording system was added. The system was used during the CLEOPATRA campaign in the DLR research aircraft Falcon 20 to measure cloud parameters. The diode pumped Nd:YAG laser we developed for the microlidar is a modification of the laser we introduced at the Lidar Congress at 'Laser 1991' in Munich. Various aspects of this work are discussed. Author

N92-31043*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. of Optoelectronics.

TRIAL OF A SLANT VISUAL RANGE MEASURING DEVICE

J. STREICHER, C. MUENKEL (Impulsphysik G.m.b.H., Hamburg, Germany, F.R.), and H. BORCHARDT (Deutscher Wetterdienst, Hamburg, Germany, F.R.) *In* NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 493-496 Jul. 1992

Avail: CASI HC A01/MF A03

Each year, fog at airports renders some landing operations either difficult or impossible. The visibility that a pilot of a landing aircraft can expect is in that case the most important information. It could happen that the visibility versus the altitude is constantly decreasing or increasing. However, it is not possible to distinguish this with the existing sensors at an airport. If the visibility is decreasing with the altitude, one has the worst case - ground fog. The standard visibility sensor, the transmissometer, determines only the horizontal visual range, which will be underestimated in comparison with the real visibility a pilot has on his landing approach. Described here is a new technique to measure the slant visual range, making use of a slant scanning device - an eye-safe laser radar. A comparison with commercial visibility sensors shows that it is possible to measure visibilities with the

slant looking laser radar in the range from 50 meters up to 2000 meters and even distinguish inhomogenities like ground fog.

Author

N92-31059*# Office National d'Etudes et de Recherches Aerospatiales, Meudon (France).

THEORETICAL SIMULATION OF A 2 MICRON AIRBORNE SOLID STATE LASER ANEMOMETER

BEATRICE IMBERT and JEAN-PIERRE CARIOU *In* NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 555-558 Jul. 1992 Sponsored in part by the Direction des Constructions Aeronautiques

Avail: CASI HC A01/MF A03

In the near future, military aircraft will need to know precisely their true airspeed in order to optimize flight conditions. In comparison with classical anemometer probes, an airborne Doppler lidar allows measurement of the air velocity without influence from aircraft aerodynamic disturbance. While several demonstration systems of heterodyne detection using a CO2 laser have been reported, improvements in the technology of solid state lasers have recently opened up the possibility that these devices can be used as an alternative to CO2 laser systems. In particular, a diode pumped Tm:Ho:YAG laser allows a reliable compact airborne system with an eye safe wavelength ($\lambda = 2.09$ microns) to be achieved. The theoretical study of performances of a coherent lidar using a solid state diode pumped Tm:Ho:YAG laser, caled SALSA, for measuring aircraft airspeed relative to atmospheric aerosols is described. A computer simulation was developed in order to modelize the Doppler anemometer in the function of atmospheric propagation and optical design. A clever analysis of the power budget on the detector area allows optical characteristic parameters of the system to be calculated, and then it can be used to predict performances of the Doppler system. Estimating signal to noise ratios (SNR) and heterodyne efficiency provides the available energy of speed measurement as well as a useful measurement of the alignment of the backscattered and reference fields on the detector. Author

36

LASERS AND MASERS

Includes parametric amplifiers.

A92-22773

WELDING OF TI 6AL 4V USING A HIGH POWER SOLID STATE LASER WITH FIBRE DELIVERY

A. P. HOULT (Lumonics, Ltd., Rugby, England) *IN*: Titanium 1990: Products and applications; Proceedings of the International Conference, Buena Vista, FL, Sept. 30-Oct. 3, 1990. Vol. 2. Dayton, OH, Titanium Development Association, 1990, p. 498-508. refs Copyright

It is presently demonstrated that it is possible to produce high-quality melt runs of 4-mm depth in Ti-6Al-4V and similar Ti alloys, using the fiber-optically channeled output of a 1-kW Nd-YAG solid-state laser. Weld quality is evaluated with a view to specific applications for which the primary advantages of this welding process, namely controlled heat input and high manufacturing flexibility, are uniquely suited. O.C.

A92-51228

SINGLE ALEXANDRITE LASER SOURCE FOR AIRBORNE DIAL SYSTEM

D. BRUNEAU, H. CAZENEUVE, J. PÉLON (CNRS, Service d'Aéronomie, Paris, France), and C. LOTH (CNRS, Laboratoire de Meteorologie Dynamique, Palaiseau, France) *IN*: OSA Proceedings on Advanced Solid-State Lasers. Vol. 10 - Proceedings of the Topical Meeting, Hilton Head, SC, Mar. 18-20, 1991. Washington, DC, Optical Society of America, 1991, p. 5-9. Research supported

by CNES. refs
Copyright

The design and characteristics of an alexandrite laser source developed for equipping an airborne DIAL system directed at atmospheric water vapor measurement for mesoscale meteorological studies are presented. Owing to the limitations of space, weight, and electric power on board the aircraft, the laser was designed to emit successively the two appropriate pulses from a single cavity and within a single flashlamp discharge. This scheme involves, in addition to the required spectral narrowing, a double Q-switch operation and a wavelength commutation between pulses. Energetic, spatial, temporal, and spectral characteristics of the laser source are given. The double pulse dual wavelength laser provides a dramatic reduction in the above requirements of the laser source of a DIAL. P.D.

N92-17434# Technische Univ., Eindhoven (Netherlands).
A DIFFRACTION LIMITED NITROGEN LASER FOR DETECTOR CALIBRATION IN HIGH ENERGY PHYSICS Ph.D. Thesis
FREDERIK GOTTLIEB HARTJES 1990 136 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie (ETN-92-90567) Avail: CASI HC A07/MF A02

The basic physical properties of the nitrogen laser, the design and performance characteristics, and a few examples of its application in high energy physics, are described. The theory of light emission and amplification as relevant for the nitrogen laser is given and illustrated by the properties of the type 1A laser. A more detailed description of the electrical characteristics of the nitrogen laser, and the implications of the laser design, are given. The development of the discharge is discussed. The mechanical construction and the beam optics are described. The physics process relevant for the application of the nitrogen laser for the calibration and test of drift chambers is discussed. ESA

N92-34152# European Space Agency, Paris (France).
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF TRANSVERSE FLOW AERODYNAMIC WINDOWS FOR HIGH POWER LASERS Ph.D. Thesis - Stuttgart Univ.
[ANALYTISCHE UND EXPERIMENTELLE UNTERSUCHUNG TRANSVERSAL GESTROEMTER AERODYNAMISCHER FENSTER FUER HOCHLEISTUNGSLASER]
EBERHARD WILDERMUTH (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) Mar. 1992 246 p Transl. into GERMAN of Analytische und Experimentelle Untersuchung Transversal Gestroemter Aerodynamischer Fenster fuer Hochleistungslaser (Stuttgart, Fed. Republic of Germany, DLR), Aug. 1990 194 p Original language document was announced as N91-16367

(ESA-TT-1251; DLR-FB-90-33; ETN-92-91965) Avail: CASI HC A11/MF A03; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

Various concepts of transverse flow aerodynamic windows are presented for use as the output element in CO₂ high power lasers. A jet of gas transverse to the optical axis screens the laser cavity against the surrounding atmosphere. More than one concept was investigated in order to optimize the optical quality and minimize the mass flow through the aerodynamic window. The particular layout for each concept and the experiments used for investigating the optical and fluid mechanics properties indicate the extent to which each of them can be employed. The design and the experimental operation of a prototype used in combination with a 5 kW CO₂ laser and the different ways of achieving laser beam output through an aerodynamic window are discussed. Beam quality calculations are compared with experimental results. ESA

MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

A92-10695

JOINTING OF COMPOSITE MATERIALS TO METALS

R. J. LEE (AEA Technology, Abingdon, England) and G. C. ECKOLD (AEA Technology, Harwell Laboratory, England) Metals and Materials (ISSN 0266-7185), vol. 7, Oct. 1991, p. 611-616. refs
Copyright

Methods for joining composite materials to metals are briefly reviewed with emphasis on aerospace applications. Particular attention is given to adhesive bonding and mechanical fastening. The discussion covers joint design, stress analysis, design optimization, and surface pretreatment. Possible future developments in composite-metal structures and joint design are briefly examined. V.L.

A92-11815

EFFECT OF PARAMETRIC NONLINEARITIES ON THE DYNAMICS AND TUNING OF SYSTEMS WITH KINEMATIC CONSTRAINTS [VLIANIE PARAMETRICHESKIKH Nelineinosti na Dinamiku i Nastroiku Sistem s Kinematicheskimi Sviaziami]

MILAN HORTEL (Czechoslovak Academy of Sciences, Institute of Thermomechanics, Prague, Czechoslovakia) Periodica Polytechnica, Mechanical Engineering (ISSN 0324-6051), vol. 34, no. 1-2, 1990, p. 123-127. In Russian.

The paper deals with the effect of parametric nonlinearities on the development of resonance vibrations in high-speed transmission systems, such as those used in aircraft and automobiles. In particular, the possibility of using system parameters to achieve resonance vibration damping in gear boxes is examined. In the context of the control theory for variable-structure systems, the use of parametric control for the tuning and damping of vibrations in systems with kinematic constraints (e.g., gears) is shown to be possible. V.L.

A92-15501

AN AXIAL TURBOBRAKE

M. I. GOODISMAN, M. L. G. OLDFIELD, T. V. JONES, R. W. AINSWORTH (Oxford, University, England), R. C. KINGCOMBE, and A. J. BROOKS (Royal Aerospace Establishment, Farnborough, England) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. Research supported by Royal Aerospace Establishment. refs (ASME PAPER 91-GT-1)

The Axial Turbobrake is a novel turbomachine which can be used to absorb power generated by test turbines. Unlike a compressor, there is no pressure recovery through the turbobrake. This simplifies the aerodynamic design and enables high-stage loadings to be achieved. The blades used have high-turning 2D profiles. This paper describes a single stage axial turbobrake, which is driven by the exhaust gas of the test turbine and is isolated from the turbine by a choked throat. In this configuration, no fast-acting controls are necessary, as the turbobrake operates automatically with the turbine flow. Tests on a 0.17 scale model show that the performance is close to that predicted by a simple two-dimensional theory, and demonstrate that the turbobrake power absorption can be controlled, and hence matched, to that typically produced by the first stage of a modern highly loaded transonic turbine. Author

A92-22785

COST EFFECTIVE SOLUTIONS FOR TITANIUM SHEET METAL FORMING

W. SWALE and R. SWALE (T.K.R. International, Ltd., Welwyn Garden City, England) IN: Titanium 1990: Products and applications; Proceedings of the International Conference, Buena

Vista, FL, Sept. 30-Oct. 3, 1990. Vol. 2. Dayton, OH, Titanium Development Association, 1990, p. 875-887. Copyright

Cost-effective solutions for titanium sheet metal forming have been developed and are being employed. Each forming process has its particular niche role to play in manufacturing the wide range of products conceived for the aerospace industry. The choice of method, however, is best made in consultation between design and manufacturer to ensure that weight, cost and performance are optimized. It is not always the case that the greatest savings come from redesigning a multipart fabrication in order to produce it as a complex on piece Superplastically Formed item but the in-service record of such components has been excellent with design allowances regularly exceeded by considerable margins. It follows, therefore, as confidence in and flexibility of the processes continue to increase so the opportunities for exploiting the benefits of titanium sheet will continue. Author

A92-33363

MODELLING OF AEROSPACE MATERIALS - NOT JUST A PRETTY PICTURE

P. D. SPILLING (Rolls-Royce, PLC, Derby, England) (Institute of Metals, Meeting on Modelling of Materials, University of Cambridge, England, Apr. 9, 1991) Materials Science and Technology (ISSN 0267-0836), vol. 8, Feb. 1992, p. 145-150. refs

Copyright

Although wide use has been made of numerical techniques to analyze material behavior, it is only recently, as a result of the increasing availability of cheap computing capacity, that such techniques have been applied to manufacturing processes. In this paper forging, casting, and quenching operations are used to illustrate the application of modeling to various manufacturing processes. The modeling technique is outlined and a brief review of the current state of development given for each operation. Author

A92-42142

AN EXPERIMENTAL STUDY ON LASER DRILLING AND CUTTING OF COMPOSITE MATERIALS FOR THE AEROSPACE INDUSTRY USING EXCIMER AND CO₂ SOURCES

M. DELL'ERBA (Centro Laser, Bari, Italy), L. M. GALANTUCCI (Bari, Politecnico, Italy), and S. MIGLIETTA (Centro Laser, Bari, Italy) (Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings. A92-42141 17-24) Composites Manufacturing (ISSN 0956-7143), vol. 3, no. 1, 1992, p. 14-19. refs

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This paper reports on the results of research which investigated the potential for the application of an excimer laser in the field of composite material drilling and cutting, by comparing this technology with that using CO₂ sources. In particular, the scope of the work was to check whether the interaction between excimer lasers and composite materials, whose characteristic feature is the absence of thermal transfer, could yield better results than those obtainable with CO₂ sources once heat transfer-induced difficulties had been eliminated. The materials selected for the experiments were multilayer composites having an epoxy resin matrix (65 percent in volume), with aramid fiber (Kevlar), carbon fiber and glass fiber as reinforcing materials, all of considerable interest for the aerospace industry. Optimal operational parameters were identified in relation to each source with a view to obtaining undersize holes or through cuts exhibiting severed areas of good quality. A comparison between the two types of processing carried out show that rims processed by excimer lasers are of better quality - particularly so with Kevlar - whereas the ablation rate is undoubtedly rather low compared with the CO₂ technology. Author

A92-42145

METAL MATRIX COMPOSITE FABRICATION PROCESSES FOR HIGH PERFORMANCE AEROSPACE STRUCTURES

C. PONZI (Alenia S.p.A., Rome, Italy) (Meeting on Industrial

Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings. A92-42141 17-24) Composites Manufacturing (ISSN 0956-7143), vol. 3, no. 1, 1992, p. 32-42. refs

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A survey is conducted of extant methods of metal matrix composite (MMC) production in order to serve as a basis for prospective MMC users' selection of a matrix/reinforcement combination, cost-effective primary fabrication methods, and secondary fabrication techniques for the achievement of desired performance levels. Attention is given to the illustrative cases of structural fittings, control-surface connecting rods, hypersonic aircraft air inlet ramps, helicopter swash plates, and turbine rotor disks. Methods for technical and cost analysis modeling useful in process optimization are noted. O.C.

A92-50779

REVIEW OF APPLICATIONS AND OF EXTENDED POWER DENSITY OF 4-CYLINDER, IN-LINE AND HERMETIC STIRLING ENGINE

STIG G. CARLQVIST (CMC, AB, Malmo, Sweden), YNGVE GOTHBERG (Swed-Recom, AB, Malmo, Sweden), GUNNAR KULLBERG (University Eskilstuna-Vasteras, Eskilstuna, Sweden), and BO TORSTENSSON (TMC, AB, Sturefors, Sweden) IN: IECEC '91, Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 211-216. Research supported by STU and University Eskilstuna-Vasteras. refs

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The four-cylinder, in-line and hermetic Stirling engine has been found to have great flexibility and thus to be suitable for various applications. For very long life internal, linear alternators are foreseen with bearings being considerably deloaded. The configuration has been adapted for use as a duplex machine with the four-cylinder, double-acting Stirling engine driving a four-cylinder, double-acting Stirling heat pump or cooling machine. Also in this case the bearings will be considerably deloaded with long life as a result. A simple and fast reaction control system has been invented, which acts by varying the pressure in the cycle, while keeping the crankcase pressure low and nearly constant. This principle is also applicable in a duplex machine with a heat pump or cooling machine, thus making it possible to arbitrarily vary the heating or the cooling power of the heat pump or the cooling machine on the one side and the amount of electricity generated on the other side. A super-alloy or ceramic high power density rating has been investigated. It is estimated that the superalloy or ceramic power rating can be combined with thermal efficiencies of well over 40 percent. I.E.

A92-54867

JOINING A NI-BASED CREEP-RESISTANT (ODS) ALLOY BY BRAZING

I. A. BUCKLOW (Welding Institute, Abington, United Kingdom) IN: Advances in joining newer structural materials; Proceedings of the International Conference, Montreal, Canada, July 23-25, 1990. Oxford and Elmsford, NY, Pergamon Press, 1990, p. 293-298. refs

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Joints are produced in a fine-grained Ni oxide-dispersion-strengthened (ODS) alloy by means of brazing alloys with and without boron, and the resulting joints are studied mechanographically. The brazing alloys employed are either sputtered coatings or foils, and brazing is conducted in a vacuum for approximately two hours. The resulting joints are examined during the process by mass spectrometry and afterwards by means of metallographic observation following etching in glyceric acid. Premature and uncontrolled recrystallization of the parent metal is noted in the samples brazed with alloys obtaining boron. The 2-micron braze coating used minimize second-phase formation and dispersoid agglomerations, and the 25-micron brazing foils lead to high porosity and dispersoid aggregation due to excessive melting. Recrystallization of the parent metal near brazing zones is

concluded to be undesirable although it does not necessarily influence the quality of the joint. C.C.S.

A92-54870 HOT MELT JOINTS FOR CARBON FIBRE REINFORCED COMPOSITES

C. NETZE and W. MICHAELI (Aachen, Rheinisch-Westfälische Technische Hochschule, Germany) IN: Advances in joining newer structural materials; Proceedings of the International Conference, Montreal, Canada, July 23-25, 1990. Oxford and Elmsford, NY, Pergamon Press, 1990, p. 361-366. refs
Copyright

The electric conductivity of carbon fibers and EVA thermoplastic adhesives in composite materials are exploited in a method for melting and/or hardening joint bonds. The joining method is based on the simultaneous use of electrical energy and mechanical pressure in joining sections of CFRP materials by means of hot melts. The EVA hot melt is used as a model adhesive to join 1:1 bidirectional CFRP sheets with a 12.5 mm overlap. Heating power is shown to affect the temperature development in the joining areas, and no relationship is noted between heating behavior and joining pressure. The strength of the bonds is comparable to the values yielded by other methods, although the carbon black in the EVA films leads to some microscopic cracks. The joining technique outlined is shown to provide effective structural bonds that could be of use in the fabrication of aircraft and other structures. C.C.S.

A92-55403 DIAGNOSTICS OF THERMAL SPRAYING PLASMA JETS

P. FAUCHAIS, J. F. COUDERT, M. VARDELLE, A. VARDELLE, and A. DENOIRJEAN (Limoges, Université, France) Journal of Thermal Spray Technology (ISSN 1059-9630), vol. 1, no. 2, June 1992, p. 117-128. refs
Copyright

The development of diagnostic techniques for dc plasma spraying is reviewed with attention given to the need for thick highly reproducible coatings of good quality for aeronautic and other uses. Among the techniques examined are fast cameras, laser-Doppler anemometry (LDA), coherent anti-Stokes Raman spectroscopy (CARS), enthalpy probes, and emission spectroscopy. Particular emphasis is given to the effect of arc fluctuations on the spectroscopic measurements, and a method is introduced for obtaining temperature and species density of vapor clouds traveling with each particle in flight. Coating properties can be deduced from data on single particles, and statistical approaches are often unreliable without added data on surface temperature and particle velocity. Also presented is a method for deriving the temperature evolution of a cooled splat and successive layers and passes. These methods are of interest to the control of adhesion and cohesion in coatings for critical aerospace applications. C.C.S.

N92-14360*# Kaiserslautern Univ. (Germany). Dept. of Mechanical Engineering.

DETERMINATION OF ROTORDYNAMIC COEFFICIENTS FOR LABYRINTH SEALS AND APPLICATION TO ROTORDYNAMIC DESIGN CALCULATIONS

P. WEISER and R. NORDMANN /n NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 p 203-221 Oct. 1991
Avail: CASI HC A03/MF A04

In today's rotordynamic calculations, the input parameters for a finite element analysis (FEA) determine very much the reliability of eigenvalue and eigenmode predictions. While modeling of an elastic structure by means of beam elements etc. is relatively straightforward to perform and the input data for journal bearings are usually known exactly enough, the determination of stiffness and damping for labyrinth seals is still the subject of many investigations. Therefore, the rotordynamic influence of labyrinths is often not included in FEA for rotating machinery because of a lack of computer programs to calculate these parameters. This circumstance can give rise to severe vibration problems especially for high performance turbines or compressors, resulting in

remarkable economic losses. The forces generated in labyrinths can be described for small motions around the seal center with a linearized force-motion relationship. Several years ago, we started with the development of computer codes for the determination of rotordynamic seal coefficients. Our different approaches to evaluate the dynamic fluid forces generated by turbulent, compressible seal flow are introduced. Author

N92-16313# National Aerospace Lab., Amsterdam (Netherlands).

DEVELOPMENT ENVIRONMENT FOR DIGITAL MANIPULATOR SIMULATORS

A. A. TENDAM and H. DEJONG 8 Feb. 1989 21 p Presented at the CAPE Nederland 1989 Congress, Amsterdam, Netherlands, 9-11 May 1989
(Contract ESA-7222/87/NL/PH; NIVR-428-02704N; NIVR-428-02606N)
(PB91-222190; NLR-TP-89030-U; AD-B155451L) Avail: CASI HC A03/MF A01

This paper discusses the realization of the development environment for digital manipulator simulators, as applied by the National Aerospace Laboratory (NLR). At present, NLR is involved in development of simulation facilities in support of the design and development of the Hermes Robot Arm. A simulator describing this manipulator has been developed with the aid of the development environment. Current research in robotics and automation is largely directed towards space robots and manipulators. The design of manipulator systems is supported by digital simulation studies. The development environment for digital manipulator simulators is to support digital simulation studies in the field of manipulator systems. In design of the development environment for digital manipulator simulators at NLR, a distinction is made between software tools and models. The desired development environment can be realized through the reuse of available software. Author

N92-21993# Technische Univ., Berlin (Germany). Fachbereich Verkehrswesen.

CONCEPT AND ANALYSIS OF AN INTEGRATED HYDROJET PROPULSION WITH A ROTATION SYMMETRICAL BOUNDARY LAYER INLET Ph.D. Thesis [KONZEPTION UND ANALYSE EINES INTEGRIERTEN STRAHLANTRIEBES MIT EINEM ROTATIONSSYMMETRISCHEN GRENZSCHICHTEINLAUF]

CHRISTIAN MASILGE 1991 86 p In GERMAN
(ETN-92-91161) Avail: CASI HC A05/MF A01

Noncontacting laser Doppler velocimetry and traditional pressure probes were used for the measurement of the pulse and energy flows at the single stations of the propulsor. The analysis of the tests, in particular of the influence of blockage effects and of the shock of the jet under water, led to an extension of the project principles around pressure coefficients for the inlet and jet exhaust. ESA

N92-25073*# Dornier-Werke G.m.b.H., Friedrichshafen (Germany).

EXPERIENCES IN THE DEVELOPMENT OF ROTARY JOINTS FOR ROBOTIC MANIPULATORS IN SPACE APPLICATIONS

KLAUS PRIESETT /n NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium p 75-89 May 1992
Avail: CASI HC A03/MF A04

European developments in robotics for space applications have resulted in human arm-like manipulators with six or more rotational degrees of freedom. The rotary joints including their own electromechanical actuator and feedback sensors must be very compact units. The specific joint concept is presented as evolved so far. The problems encountered during the first hardware development phases are covered on both component and joint level. Author

N92-27304*# Centre National d'Etudes Spatiales, Toulouse (France).

NEW RESULTS FROM FRECOPA ANALYSIS Abstract Only

CHRISTIAN DURIN /In NASA. Langley Research Center, Second LDEF Post-Retrieval Symposium Abstracts p 100 Jun. 1992
 Avail: CASI HC A01/MF A02

Given Long Duration Exposure Facility (LDEF) new situation (5.8 years mission), CNES decided to set up a team to analyze FRECOPA systems (AO 138). We studied the kinematic system first. We observed damage on the DELRIN gears and lubricant ageing. The results are based on comparative appraisals between components after flight and those stored on ground in laboratory conditions. We observed also the aluminum surface treatment in the exposed areas and we measured the thermo-optical properties changes. Now, with all the results stored, we try to give a ruling on the use of FRECOPA materials in space environment. Author

N92-27743* Eidgenoessische Technische Hochschule, Zurich (Switzerland). Mechatronics Lab.

CONTROL CONCEPTS FOR ACTIVE MAGNETIC BEARINGS

ROLAND SIEGWART (MECOS Traxler A.G., Winterthur (Switzerland).), D. VISCHER (MECOS Traxler A.G., Winterthur (Switzerland).), R. LARSONNEUR (MECOS Traxler A.G., Winterthur (Switzerland).), R. HERZOG (MECOS Traxler A.G., Winterthur (Switzerland).), ALFONS TRAXLER (MECOS Traxler A.G., Winterthur, Switzerland), H. BLEULER (MECOS Traxler A.G., Winterthur (Switzerland).), and G. SCHWEITZER /In NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 401-422 May 1992
 Avail: CASI HC A03/MF A04

Active Magnetic Bearings (AMB) are becoming increasingly significant for various industrial applications. Examples are turbo-compressors, centrifuges, high speed milling and grinding spindles, vibration isolation, linear guides, magnetically levitated trains, vacuum and space applications. Thanks to the rapid progress and drastic cost reduction in power- and micro-electronics, the number of AMB applications is growing very rapidly. Industrial uses of AMBs leads to new requirements for AMB-actuators, sensor systems, and rotor dynamics. Especially desirable are new and better control concepts to meet demand such as low cost AMB, high stiffness, high performance, high robustness, high damping up to several kHz, vibration isolation, force-free rotation, and unbalance cancellation. This paper surveys various control concepts for AMBs and discusses their advantages and disadvantages. Theoretical and experimental results are presented. Author

N92-33538* Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.

RADIAL INFLOW TURBINE STUDY Interim Report No. 7

S. HAMID and R. L. ELDER Mar. 1992 11 p

(Contract DAJA45-89-C-0006)

(AD-A252783; R/D-5824-AN-01) Avail: CASI HC A03/MF A01

The radial inflow turbine is a primary component used both in small gas turbines and turbochargers. Better understanding of the flow processes occurring within the small passages of the machine could well result in the improved design of units. As most of the detailed aerodynamics is still ill-defined, a joint research project with the objective of improving our understanding has been instigated by Cranfield, the US Army and Turbomach (San Diego). This document gives the seventh report on the project and describes progress and measurements taken. GRA

QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

A92-15624

COMBINATION OF DIFFERENT UNSTEADY QUANTITY MEASUREMENTS FOR GAS TURBINE BLADE FAULT DIAGNOSIS

E. LOUKIS, P. WETTA, K. MATHIOUDAKIS, A. PAPATHANASIOU, and K. PAPAILIOU (Athens, National Technical University, Greece) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. Research supported by Hellenic General Secretariat for Research and Technology and EEC. refs
 (ASME PAPER 91-GT-201)

The exploitation of different unsteady quantity measurements for identifying various blade faults is examined in this paper. Measurements of sound emission, casing vibration, shaft displacement and unsteady inner wall pressure are considered. It is demonstrated that particular measurements are sensitive to specific faults. The suitability of measuring each of the above physical quantities for tracing the existence of each kind of fault is discussed. The advantage of combining different measurements originates from the possibility of extending the fault repertory covered when only one particular quantity is considered. The data analysis techniques employed range from conventional signal processing to the derivation of acoustic images of the engine outer surface. Relative features of each technique, as to their effectiveness and level of intrusivity, are discussed. Author

A92-15661

A PROCEDURE FOR AUTOMATED GAS TURBINE BLADE FAULT IDENTIFICATION BASED ON SPECTRAL PATTERN ANALYSIS

E. LOUKIS, K. MATHIOUDAKIS, and K. PAPAILIOU (Athens, National Technical University, Greece) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 9 p. refs
 (ASME PAPER 91-GT-259)

A method for diagnosing the existence and the kind of faults in blades of a gas turbine compressor is presented. The innovative feature of this method is that it performs the diagnosis automatically, namely it gives a direct answer to whether a fault exists and what fault it is, without requiring the interpretation of results by a human expert. This is achieved by the derivation of the values of discriminants calculated from spectral patterns of fast response measurement data. A decision about the corresponding engine status is then derived according to the values of these discriminants. Author

A92-38088

NON-DESTRUCTIVE INSPECTION OF CARBON FIBRE-REINFORCED PLASTICS USING EDDY CURRENT METHODS

M. P. DE GOEJE and K. E. D. WAPENAAR (TNO, Delft, Netherlands) Composites (ISSN 0010-4361), vol. 23, no. 3, May 1992, p. 147-157. Research supported by Ministry of Economic Affairs of Netherlands. refs
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The possibilities and limitations of eddy current methods for the inspection of carbon fiber-reinforced plastics have been investigated. The electrical properties of these composites lead to modifications of current methods applied to metals; in particular the required frequencies are much higher, -1-30 MHz for weave and 10-500 MHz for unidirectional reinforcements. A proper design of the probes is essential. Fiber orientations can be detected conveniently with dedicated probes using a polar scan technique. The eddy currents are insensitive to delaminations. Only for

unidirectional reinforcements and extensive delamination, over 20 percent, is the effect large enough to show up in C-scan images. In contrast, fiber fracture is readily detected for unidirectional and weave reinforcements, with a lower limit of about 8 percent fracture. As a result, eddy current methods are useful to establish the type of defect when a composite is damaged. Author

A92-51950

DISCS LOW CYCLE FATIGUE LIFE PREDICTIONS FOR GAS TURBINE ENGINES IN CSFR BY USING FRACTOGRAPHIC INFORMATION

JIRI STATECNY, JAN DREXLER, and ANTONIN JANAK Zprava VZLU, no. Z-64, 1991, p. 1-18. refs
Copyright

Besides the conventional SL (Safe Life) philosophy for disk cyclic life predictions, the DT (Damage Tolerance) philosophy starts to be used in connection with the RFC (Retirement for Cause) strategy. The present paper is aimed especially at the certification demonstrations proofs. The use of advanced life prediction approaches is quite dependent on a reliable NDI (Nondestructive Inspection Technique). Therefore the reliability of the information gained by NDI macrographic findings during the LCF (Low Cycle Fatigue) tests must be verified by micrographic analysis of the failed components. The approach used in ARTI and some experience from tests are presented. Several models have been developed in ARTI in recent years as a means for life prediction on a probabilistic basis. A new one is presented which may be useful for disks with critical circumferentially shaped concentrators. Author

A92-54862

STATE OF COMPOSITE MATERIAL STRUCTURE CONTROL IN SITU

M. HUTHER and M. JOUAN (Bureau Veritas, Levallois-Perret, France) IN: Advances in joining newer structural materials; Proceedings of the International Conference, Montreal, Canada, July 23-25, 1990. Oxford and Elmsford, NY, Pergamon Press, 1990, p. 203-208. refs
Copyright

A review is given of methods available for the metallurgical control and NDT evaluations of composite materials with attention given to their limitations. Among the techniques examined are holography, acoustic emission, and extensometry. The development of automated ultrasonic control techniques is leading to more routine use in such industrial applications as aircraft fabrication.

C.C.S.

N92-14431# Deutsche Airbus G.m.b.H., Bremen (Germany).

A CONCEPT FOR THE REVISIONS OF STRUCTURAL INSPECTION SCHEDULES

H.-J. MEYER and L. SCHWARMANN In Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 31 p 1991
Avail: CASI HC A03/MF A01

Revisions of established inspection schedules should not only be released in case of an in service finding, but also institutionally updated following an Airframe Condition Monitoring Procedure (ACMP). In order to improve methods and inspection procedures, it is aimed to perform an inspection just when a crack reaches its detectable length or, more realistically, to schedule inspections closer to damage. Since aircraft utilization and loading environment differ individually, a closer to damage inspection schedule must account for these differences. The basic general inspection program has to be attuned to the actual service experience for each individual aircraft. It is anticipated that reliable tools for individual aircraft tracking will soon be available and a Flexible Response Inspection Schedule (FRIS) can be established. ACMP, a software system comprising all data processing necessary to transfer collected airline service data into a structural inspection adjustment program, is considered. Update sequences will ensure continuing lifelong structural reassessment. Monitoring a fleet with ACMP will for the first time provide relations between aircraft utilization, including environment, and occurrence of damage.

During the life of the aircraft, the Schedule for Structural Inspection (SSI) of the Maintenance Review Board (MRB) is expected to change completely from the originally supposed SSI to in service findings. Although the main objective of ACMP is to adjust inspection threshold and intervals, ACMP results can on the other hand be used to change aircraft operation in order to extend intervals or to postpone thresholds or even repair and replacement actions. ESA

N92-17544# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Space Communications and Propulsion Systems Div. CONSTRAINTS AND DIFFICULTIES IN IMPLEMENTATIONS OF RAMS ASSURANCE PROGRAMMES

MIODRAG CULJKOVIC 1991 4 p Presented at the ESA Symposium on Space Product Assurance for Europe in the 1990s, Noordwijk, Netherlands, 15-19 Apr. 1991 (MBB-UK-0141-91-PUB; ETN-92-90602) Avail: CASI HC A01/MF A01

A summary of typical difficulties encountered in the implementation of Reliability, Availability, Maintainability, and Safety (RAMS) assurance programs as observed in numerous space companies is given. An attempt is made to suggest possible solutions for each listed problem in order to improve the situation and support more effective RAMS assurance management in the years to come. The external and internal difficulties which have impeded RAMS engineers in all space companies are discussed. Ways in which to overcome these difficulties are proposed. ESA

N92-18608# Eurospace, Paris (France).

INTERNATIONAL COLLABORATION IN PA AND SAFETY, THE EUROSPACE PA-PANEL

J. LEVOLD (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 5-8 Aug. 1991
Copyright Avail: CASI HC A01/MF A03

The EUROSPACE Product Assurance (PA) Panel, an active body of senior representatives from aerospace industry gathered to interact with the European Space Agency (ESA) on standards and requirements, is described. Comments on Procedures, Specifications, and Standards-01 (PSS-01) requirements, as well as actual implementation on Ariane 5, Columbus, and Hermes, are presented. A tendency towards overspecification and demand for bureaucratic tasks must be avoided, and the international competitiveness of the space industry in non ESA projects enhanced. Recommendations towards this aim and improved collaboration between ESA and industry are made. ESA

N92-18629# Technical Research Centre of Finland, Tampere. Safety Engineering Lab.

QUALITY ASSURANCE OF SAFETY AND RISK ANALYSIS

V. ROUHIAINEN and J. SUOKAS In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 135-140 Aug. 1991

Copyright Avail: CASI HC A02/MF A03

Safety and risk analysis forms an essential part of the implementation of the ESA system safety program requirements. In a major attempt to promote high quality levels, a set of standards and guidelines on hazard identification and risk assessment is presented. The application of safety and risk analysis continues to increase in the process industries. However, the increasing application of risk assessment incurs the need for more precise knowledge of the limitations of the different risk analysis methods and for more explicit definitions of the acceptable levels of detail of both the analysis and the documentation required. The main problems encountered in the field are the quality of the analyses and the resources needed for the analyses. A new method QUASA (Quality Assessment of Safety Analysis) is described and preliminary experiences reviewed. QUASA was developed to meet the needs of the process industries. Some possibilities for the adaptation of QUASA to space technology are discussed. ESA

N92-18632# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Design Assurance Dept.

PRODUCT ASSURANCE AND SAFETY IMPLEMENTATION ON SPACE SHUTTLE PAYLOADS: AN INDUSTRIAL PERSPECTIVE
IAN JENKINS *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 153-158 Aug. 1991 (MBB-UK-0143-PUB; OTN-033151) Copyright Avail: CASI HC A02/MF A03

Experiences and observations gained in the Product Assurance (PA) and safety field in processing Space Shuttle payloads are summarized with a view to providing some direction for future programs as Europe begins to implement its own manned space ventures. A summary of Space Shuttle payloads at MBB is presented. The PA and safety requirements used are specified. Experiences in management of a safety assurance program in a commercial environment are provided, and oversight of PA and safety aspects in externally furnished equipment are explained. Experiences and trends with Space Shuttle payload safety reviews are discussed. ESA

N92-18633# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

RELIABILITY MODELING FOR NON-ELECTRONIC SYSTEMS
N. VALISENA (European Space Research Lab., Noordwijk (Netherlands).) and T. DEMOLLERAT (Aerospatiale, Cannes, France) *In* its Space Product Assurance for Europe in the 1990s: An ESA Symposium p 159-163 Aug. 1991 Copyright Avail: CASI HC A01/MF A03

An original approach for reliability modeling of nonelectronic systems is described. Failure rate models are not used in this approach as they are relatively undependable in this area. Specific models, depending on both design margins and quality provisions for realization aspects, are proposed. Examples of such models and rules of combination of the models at system level are given. The results of research conducted on typical probabilities, in space operations, for human errors/inspection efficiencies are presented. ESA

N92-18639# Technische Univ., Delft (Netherlands).

RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND SAFETY Abstract Only

A. HALE (Technische Univ., Twente (Netherlands).), G. L. ROTH (MATRA Espace, Paris-Velizy (France).), M. CULJKOVIC, P. CHARRON, and K. WRIGHT (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 191 Aug. 1991 Copyright Avail: CASI HC A01/MF A03

The role of Reliability, Availability, Maintainability and Safety (RAMS) engineers in space programs is discussed. Difficulties that management have in dealing with risk reduction are considered. The problem of convincing designers that the RAMS engineers are not offering only criticism but an additional viewpoint that improves design quality is discussed. It is recommended that RAMS engineers spend more time on modeling an analysis. As 80 pct. of decisions are made in the first 10 pct. of the work, the need to develop fast and effective models is stressed. ESA

N92-18645# Alenia, Torino (Italy).

A PRODUCT ASSURANCE ENGINEERING CONCEPT FOR COMPLEX SPACE SYSTEMS

MARIO FERRANTE and DANILO FOLTRAN *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 229-236 Aug. 1991 Copyright Avail: CASI HC A02/MF A03

With the increase in complexity of each generation of space system infrastructures and the associated increase in cost and risks, the reliability, availability, maintainability, and safety (RAMS) disciplines are becoming very important as design drivers in assuring the definition of system architectures which are truly optimized for redundancies, mass, cost, and other resources. A product assurance engineering concept developed with the

intention of influencing system design and development from the early phases of the project that ensures the incorporation of RAMS requirements into the system architecture is described. The methodology used to establish a space system architecture through analysis based on functions tree, functional Failure Mode Effect and Criticality Analysis (FMECA), software criticality analysis, and critical functions list is described. It is shown how these analyses are used to generate the RAMS requirements to be applied to the system and subsystems. ESA

N92-18648# Exeter Univ. (England). School of Engineering.

RELIABILITY MODELING OF THE SYSTEMS WHOSE COMPONENTS HAVE NON-CONSTANT FAILURE RATE

J. KNEZEVIC *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 249-252 Aug. 1991 Copyright Avail: CASI HC A01/MF A03

A method for the reliability modeling of future systems whose modules, parts, and components demonstrate non-constant failure rates is described. The method is particularly important for spacecraft which represent a very complex engineering system whose reliability characteristics are as important as performance and cost. The approach presented is demonstrated through a numerical example. ESA

N92-18651# Erno Raumfahrttechnik G.m.b.H., Bremen (Germany).

COLLECTION OF PRODUCT ASSURANCE DATA AND THEIR EFFECTIVE UTILIZATION

L. HAUPT *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 267-272 Aug. 1991 Copyright Avail: CASI HC A02/MF A03

A study performed under ESA contract on the subject of Product Assurance Data (PADATA) is described. It starts with the collection of PADATA in the fields of aircraft operations, nuclear, offshore oil, and space industries. The study compares the different approaches taken and proposes a list of basic objectives for the collection of PADATA. A typical PADATA list and a list of typical PA/QA (Product Assurance/Quality Assurance) functions involved in a space project under ESA Procedure, Specifications, and Standards (PSS) Requirements is presented. Standardization, harmonization, and tailoring of documentation requirements to project needs is discussed. Preconditions of an effective data retrieval system are outlined. Possible approaches to collection of project support data and identification and computerized retrieval of capability data technical memory in the sense of computer aided quality assurance (CAQ) are considered. The study focuses on a proposal for a computer aided flow mapping scheme of the data needed and produced by the typical functions involved in a space project. ESA

N92-19005# Rolls-Royce Ltd., Derby (England).

INTRODUCTION: NEEDS AND APPROACHES TO RELIABILITY AND QUALITY ASSURANCE IN DESIGN AND MANUFACTURE

A. C. PICKARD *In* AGARD, AGARD/SMP Review: Damage Tolerance for Engine Structures. 4: Reliability and Quality Assurance 4 p Dec. 1991 Previously announced as N91-10297

Copyright Avail: CASI HC A01/MF A01

In the damage tolerance approach for improving the integrity of aircraft engines, reliability and quality assurance issues are discussed. The implications of the following aspects on the damage tolerance concept are studied: component material specifications and standards; controls on manufacturing processes and procedures; and design systems and quality assurance. The subjects reviewed in the workshop on reliability and quality assurance are given. Author

N92-19108# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.

QUALITY ASSURANCE REQUIREMENTS FOR ESA SPACE SYSTEMS

Feb. 1991 83 p

(ISSN 0379-4059)

(ESA-PSS-01-20-ISSUE-2; ETN-92-90751) Copyright Avail:
CASI HC A05/MF A01

The quality assurance (QA) requirements which implement the European Space Agency (ESA) QA Policy and which are applicable to ESA Space Systems are defined. QA program management is described. QA general requirements and QA specific requirements for design and development, procurement, manufacturing, assembly, integration and test, and acceptance and delivery are presented. ESA

N92-23258# International Atomic Energy Agency, Vienna (Austria).

TRAINING GUIDELINES IN NON-DESTRUCTIVE TESTING TECHNIQUES

Oct. 1991 274 p In SPANISH

(DE92-615083; IAEA-TECDOC-628/S) Avail: CASI HC A12/MF A03

Non-destructive testing methods (NDT), by their very nature, allow components to be fully examined for properties or flaws without interfering with their usefulness. This grouping of inspection methods has grown from a few primitive techniques practiced by artists to a widely known discipline which is an essential part of quality control, largely as a result of the standards demanded by the nuclear and aerospace industries. Recognizing the need for an international publication of NDT training syllabi, the IAEA Consultants Meeting on 'Qualification and Certification of NDT Personnel' (Milan, 20-21 May 1986), recommended that the Agency publish the guidelines developed by Regional Working Group of the Latin America and Caribbean project. It was first issued in English in 1987 and has now been re-edited in English and Spanish and enlarged by the addition of programs for other techniques. DOE

N92-29878# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.

MAINTAINABILITY REQUIREMENTS FOR ESA SPACE SYSTEMS

Nov. 1991 28 p

(ISSN 0379-4059)

(ESA-PSS-01-50-ISSUE-1; ETN-92-91385) Copyright Avail:
CASI HC A03/MF A01

Maintainability program management, engineering, analyses, assessment, demonstration and data collection are specified. The requirements defined apply to all systems where maintenance is to be used to achieve or sustain system capabilities for mission success. The software part of systems are not addressed. The ESA maintainability assurance policy, basic approach, quantitative maintainability requirements, and applicable documents, are outlined. ESA

39

STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

A92-11830

DYNAMIC CHARACTERIZATION AND IDENTIFICATION OF NONLINEAR SYSTEMS APPLICATION TO AERONAUTICAL STRUCTURES

MARC LEPART (ONERA, Chatillon, France) La Recherche Aérospatiale (English Edition) (ISSN 0379-380X), no. 3, 1991, p. 23-32. refs

Copyright

An error function used to demonstrate the presence of nonlinear phenomena in the determination of the dynamic behavior of structures using curve fitting of frequency response functions is

proposed. The function also characterizes the types of nonlinearities. The function serves as a criterion for the quality of curve fitting, helping the operator to choose a nonlinear model leading to the smallest error at the lowest computation cost.

C.D.

A92-12346

EXPERIMENTAL DETERMINATION OF THE CENTER OF MASS, THE PRINCIPAL CENTRAL AXES OF INERTIA AND MOMENTS OF INERTIA [DOSWIADCZALNE WYZNACZANIE POLOZENIA SRODKA MASY I GLOWNYCH CENTRALNYCH OSI BEZWLADNOSCI ORAZ WARTOSCI MOMENTOW BEZWLADNOSCI SAMOLOTU]

ANDRZEJ SWIDER (Instytut Lotnictwa, Warsaw, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 52-71. In Polish. refs

The methods presented make possible to determine experimentally the coordinates of the mass center and the principal central axes of inertia with an error assessment. Measurements are taken many times so that statistical results can be obtained. The center of mass is measured by the added mass method. It is based on the equilibrium deflection of a suspended aircraft caused by some additional masses. Coordinate values are computed from the deflection angles. In order to measure MI and the principal axes location a simple pendulum method is used. Multiple measurements for changed oscillation axes give a moment versus deflection angle curve. It was used to determine the above parameters. The methods presented were tested on an aircraft model and then applied to real aircraft. Author

A92-13540

DISPERSION CURVES ANALYSIS FOR BONDED PLATES AT LOW FD

F. LEOMY, M. DE BILLY, G. QUENTIN (Paris VII, Université, France), Y. BENELMOSTAFA, J. F. DE BELLEVAL, N. MERCIER (Compiègne, Université de Technologie, France), I. MOLINERO, and D. LECURU (Aérospatiale, Centre Commun de Recherche, Suresnes, France) IN: Review of progress in quantitative nondestructive evaluation. Vol. 9A. New York, Plenum Press, 1990, p. 219-225. refs

(Contract DRET-87-488)

Copyright

An analysis is presented of the dispersion curves of a three-layered structure at low F_d . The possibility of using the lowest modes to get information about interfacial weakness defects at the interface between duraluminum and epoxy layers is discussed. The dispersion curves are given. C.D.

A92-15222

OPTIMIZATION OF THE FLUTTER LOAD BY MATERIAL ORIENTATION

OLE JORGENSEN (Technical University of Denmark, Lyngby) Mechanics of Structures and Machines (ISSN 0890-5452), vol. 19, Sept. 1991, p. 411-436. refs

Copyright

The present work concerns optimization of the stability of composite plates for supersonic flutter. A finite element model of the structure is applied. The individual material orientation within each finite element defines the degrees of freedom in the design space. Design iterations are based on analytical sensitivity analyses, derived by Pedersen and Seyranian. Plaut's flutter instability condition is discussed. The condition implies the possibility of an accurate flutter analysis without reducing the eigenvalue problem. For one particular choice of material, an optimal design, in the case of a rectangular, simply supported plate, is found. Design iterations on a delta-shaped plate supported as a cantilever are discussed. A condition for when static divergence is not a possible consequence of the aerodynamic load for any design is derived. Author

A92-19677

FATIGUE AND DAMAGE TOLERANCE VERIFICATION OF AIRCRAFT STRUCTURES

ANDERS F. BLOM (Aeronautical Research Institute of Sweden, Bromma) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 13-22. refs Copyright

The position is argued that to provide and maintain aircraft structural integrity comprehensive treatment be given to such interrelated issues as maintenance, testing, stress analysis, and load budgets. An overview is given of procedures related to damage-tolerance verification and fatigue analysis including initial flaw-size assumptions. The analytical concepts set forth emphasize the identification of fatigue-critical areas, the calculation of stress-intensity factors, and experimental truncation tests. Load spectra, interactions, and monitoring techniques are mentioned, and a protocol for structural testing is outlined. Durability of aircraft structures is found to be related to proper inspection and repair, whereas structural integrity relies primarily on data regarding flight profiles, the resulting load spectra, stress distributions, and material properties. C.C.S.

A92-19697

FATIGUE LIFE ANALYSIS FOR VARIABLE-AMPLITUDE LOADING

JUSSI SOLIN (Technical Research Centre of Finland, Metals Laboratory, Espoo) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 477-486. Research supported by Technology Development Centre of Finland, Nordic Industrial Foundation, Outokumpu Oy, and Rauma-Repol Oy. refs Copyright

The analytical treatment of spectrum-fatigue tests is described in which a mean-damage method is employed to assess equivalent loading. The adopted philosophy of fatigue design is discussed, and constant-amplitude loading is examined in relation to the root-mean m method which is contrasted with the mean-damage method. The damage-based analysis employs the Paris equation to evaluate the spectrum-fatigue test results, and the technique is based on the use of equivalent constant-amplitude loading. Reference is made to tests of different material/spectrum combinations in which the described method was utilized. It is shown that the mean-damage method is less sensitive to the assumed damage exponent m than the root-mean m method. The equivalent-loading method permits the determination of fatigue-design curve by spectrum loading in the laboratory design phase of aircraft structure designs. C.C.S.

A92-21216

LINEAR PANEL FLUTTER OF AN ELLIPTIC CYLINDRICAL SHELL

M. KOZAROV and T. VODENICHAROVA (Higher Institute of Architecture and Civil Engineering, Sofia, Bulgaria) Archive of Applied Mechanics (ISSN 0939-1533), vol. 61, Dec. 1991, p. 505-516. refs Copyright

Panel flutter of an elliptic cylindrical shell exposed to an external supersonic air stream is investigated. Shallow cylindrical shell deformation theory and aerodynamic piston theory are used. The displacement function is expressed in two variants. A comparison between the results obtained by both versions is made. Numerical results for shells with different geometric parameters are shown. Hereby, the shell is considered as a system with two and with four degrees of freedom. The purpose of the investigation is to determine the variation of critical flutter Mach number with shell parameters. Author

A92-27150

A DISCRETE DYNAMIC MODEL OF ROTATING SHELL-PLATE-DISK STRUCTURES

Z. DZYGADLO, J. NOWOTARSKI, A. OLEJNIK, and P. ZALEWSKI (Military Technical Academy, Warsaw, Poland) Journal of

Technical Physics (ISSN 0324-8313), vol. 32, no. 2, 1991, p. 267-291. refs

Copyright

General relations are derived for the vibration analysis of rotating axially symmetric shell-plate-disk systems. For this purpose, a two-dimensional discretization of the structure is performed by using trihedral ring elements. The resulting relations are implemented in a microcomputer code written in FORTRAN for evaluating the natural and forced frequencies and modes of rotor assemblies. The usefulness of the program is verified by applying it to the vibration analysis of the rotor of an aircraft turbine engine. V.L.

A92-48592

NUMERICAL ANALYSIS OF AN ENGINE TURBINE DISK LOADED WITH A LARGE NUMBER OF THERMOMECHANICAL CYCLES

S. KRUCH (ONERA, Chatillon, France) (Complas III - International Conference on Computational Plasticity Fundamentals and Applications, 3rd, Barcelona, Spain, Apr. 6-10, 1992) ONERA, TP no. 1992-31, 1992, 13 p. refs

(ONERA, TP NO. 1992-31)
A new numerical methodology, named 'cycle jump technique' for the analysis of complex behavior of structures subjected to large thermomechanical loads is developed and applied to analyze a SNECMA aircraft engine turbine disk loaded with a large number of thermomechanical cycles. The cycle jump technique, implemented in the EVPCYCL computer code, is able to avoid cycle-by-cycle computations when the variation of the local governing parameters, such as viscoplastic strain and damage, do not change significantly between cycles. The cycle jump technique calculation required over 500 cycles before reaching the stabilized cycle and being in position to analyze the state of the stresses in the critical areas of the structure, demonstrating the importance and effectiveness of the technique. I.S.

A92-48613

ELASTO-ACOUSTIC DAMPED VIBRATIONS - FINITE ELEMENT AND MODAL REDUCTION METHODS

V. KEHR-CANDILLE and R. OHAYON (ONERA, Chatillon, France) (DGLR and AIAA, Aeroacoustics Conference, 14th, Aachen, Federal Republic of Germany, May 11-14, 1992) ONERA, TP no. 1992-52, 1992, 8 p. Research sponsored by Aerospatiale. refs

(ONERA, TP NO. 1992-52)
The problem of internal, 'low-frequency', noise reduction for aeronautical structures is addressed. Attention is focused on noise reduction by passive systems for very thin layers, employing direct finite element analysis of the structural-acoustic coupled system, and alternative reduction modal methods adapted to dissipative interface damping. Numerical results are given for both analyses to demonstrate the feasibility, the versatility and the accuracy of the modal projection analysis. R.E.P.

A92-51745

STRESSES IN ROTATING, ORTHOTROPIC, CIRCULAR, COMPOSITE DISKS AND PLATES

U. YUCEOGLU, F. TOGHI, and K. YAVUZ (Middle East Technical University, Ankara, Turkey) IN: Recent developments in composite materials structures; Proceedings of the Symposium, ASME Winter Annual Meeting, Dallas, TX, Nov. 25-30, 1990. New York, American Society of Mechanical Engineers, 1990, p. 61-65. refs Copyright

Rotating disks are used extensively in technology as flywheels in energy storing devices and as rotors in gas turbines and aircraft jet engines. In this analysis, the rotating, circular disk is assumed to be a relatively thick, orthotropic plate rotating about its axis with a constant angular velocity. The boundary value problem is formulated in terms of displacements which are functions of 'r' and 'z' coordinates. The solution is obtained in closed form, based on classical linear elasticity theory. Numerical results and conclusions are given for some sample problems. The extension of the solution into composite disks with two or more orthotropic layers are also considered. Author

A92-56866

A DYNAMIC STIFFNESS TECHNIQUE FOR THE VIBRATION ANALYSIS OF STIFFENED SHELL STRUCTURES

R. S. LANGLEY (Cranfield Institute of Technology, United Kingdom) *Journal of Sound and Vibration* (ISSN 0022-460X), vol. 156, no. 3, Aug. 8, 1992, p. 521-540. refs
Copyright

A dynamic stiffness method is presented for the analysis of stiffened shell structures. The method is based on a singly curved orthogonally stiffened shell element which has a constant radius of curvature and which is simply supported along the curved edges. The stiffeners are taken to be smeared over the surface of the element, and Hamilton's principle is used to derive the appropriate modifications which must be made to the shell differential equations and boundary conditions. The resulting differential equations are solved exactly to yield the dynamic stiffness matrix and the loading vector for the element. Any number of elements may be assembled to model the cross-section of a built-up structure such as an aircraft fuselage. A discrete stringer element is also derived which enables the detailed analysis of smaller structural components such as an array of stiffened panels. The method is applied to a range of stiffened circular cylinders, a cylinder with an internal floor, and a five-panel/six-stringer array. Author

A92-57399

EFFECTS OF SPECTRUM VARIATIONS ON FATIGUE CRACK GROWTH

A. LANCIOTTI and L. LAZZERI (Pisa, University, Italy) *International Journal of Fatigue* (ISSN 0142-1123), vol. 14, no. 5, Sept. 1992, p. 319-324. Research supported by Rinaldo Piaggio S.p.A. refs
Copyright

Results are presented of an experimental program carried out in support of the certification of the Piaggio P.180 aircraft. In these tests, particular attention was given to the effects of truncating high loads and of omitting small cycles on fatigue-crack propagation. The results of tests are compared to analytical predictions, obtained by using a simple closure model, and with published experimental results. I.S.

N92-12313# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.

A REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN SWEDEN DURING THE PERIOD MAY 1989 TO APRIL 1991

ANDERS F. BLOM, ed. 13 May 1991 73 p Presented at 22nd International Committee on Aeronautical Fatigue Conference, Tokyo, Japan, 20-21 May 1991 Sponsored by Swedish Defence Material Administration

(FFA-TN-1991-24; ETN-91-90288) Avail: CASI HC A04/MF A01

Work carried out in Sweden in the area of aeronautical fatigue is reviewed. Measurements of aircraft loading actions, basic studies of fatigue development in metals and composites, stress analysis and fracture mechanics, studies of crack propagation and residual strength, testing of joints and full scale structures, and fatigue life predictions are included. ESA

N92-14382# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

APPLICATION OF MSC/DYNA TO SHOCK AND IMPACT PROBLEMS IN AIRCRAFT INDUSTRY

KLAUS WOLF (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.)), IOANNIS NITSPOULOS (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.)), HARALD SUSKI (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.)), and DETLEF LIEBE (Mac-Neal-Schwendler G.m.b.H., Munich, Germany, F.R.) 19 Mar. 1991 19 p Presented at the 18th MSC European Users' Conference, Prien am Chiemsee, Fed. Republic of Germany, 19-21 Jun. 1991

(MBB-UD-0593-91-PUB; OTN-021385; ETN-91-90195) Avail: CASI HC A03/MF A01

Applications to important problems in aircraft industry are presented. In the first one the so called Hammershock and the flight loads are forcing the intake of a jet engine plane. The flight

loads as the static part are treated with MSC/NASTRAN for efficiency, the hammershock as the highly transient with MSC/DYNA. How to combine these totally different calculations is described. The second problem is about an impact of a steel sphere on a fabric laminated plate. Using the failure criterion of SIMO-Chang, it can be shown, that, after the sphere has bounced off, the plate is partly destroyed caused by failed plies and remaining deformations. Considering the assumptions made the results of MSC/DYNA are in good agreement with the experiment. ESA

N92-14397# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany).

REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY Review Period, Jun. 1989 - May 1991

O. BUXBAUM and A. SCHOEPFEL 1991 65 p Presented at 22nd International Committee on Aeronautical Fatigue, Tokyo, Japan, 1991

(ETN-92-90317) Avail: CASI HC A04/MF A01

Results of investigations in the field of fatigue gained by industry and research organizations are summarized. Most of the subjects are fatigue test results from specimens and components under constant amplitude; program and random loading. Other reports concern investigations about the cyclic stress strain behavior as well as crack propagation, fracture mechanics, and residual strength. A considerable amount of reports on investigations of composite materials, especially of graphite/epoxies and their properties under environmental influence, are included. ESA

N92-14420# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany).

DESIGN AND FATIGUE BEHAVIOUR OF A CFRP/TITANIUM JOINT FOR THE PROPPAN ENGINE CRISP

M. BERG (Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.)), O. PETER (Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.)), and J. FRISCHBIER (Motoren- und Turbinen-Union Muenchen G.m.b.H., Germany, F.R.) *In its Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany* 2 p 1991

Avail: CASI HC A01/MF A01

A Counter Rotating Integrated Shrouded Propfan (CRISP) is investigated for civil aircraft application to reduce field consumption, to reduce noise, and to increase take off thrust. Limitations in size of the propfan engine and the enormous centrifugal forces caused by the fan blades, led to the use of Carbon Fiber Reinforced Plastics (CFRP) material for the blades. The design of the joint between the CFRP fan blades and the titanium blade roots is considered. A feasibility study carried out recommends a combination of riveting and adhesive bonding for the CFRP/titanium joint of the experimental propfan. The study contains recommendations of geometry, surface treatment, type of adhesive, and bonding process as well as a strength evaluation of the joint. Tests performed to evaluate the joint between titanium blade root and CFRP are listed. The experimental program will be finished by the end of 1991. ESA

N92-14428# Deutsche Airbus G.m.b.H., Hamburg (Germany).

METHODOLOGY FOR ASSESSMENT OF SKIN REPAIRS ON AIRBUS AIRCRAFT

B. BRANDECKER and U. SCHMAELZLE *In Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany* 2 p 1991

Avail: CASI HC A01/MF A01

The assessment of existing repairs on in-service aircraft, i.e., the determination of necessary inspection threshold and intervals, and/or time of modification or replacement for each repair, is discussed. Static aspects as well as fatigue and damage tolerance aspects are considered. A new methodology which includes guidance material allowing operators to assess the repairs without both complex calculation and support from the manufacturer is reviewed. For example, wing repairs cannot be generalized. The

39 STRUCTURAL MECHANICS

methodology is limited to the fuselage and vertical tail and comprises the following subjects: skin and longitudinal lap joint repairs; circumferential joint repairs; door skin repairs; repairs of door surrounding frames; repairs around door cut outs; repairs of vertical tail skin. As an example, the basic features of the method used for assessing skin and lap joint repairs are described. ESA

N92-18573# Centre d'Essais Aeronautique Toulouse (France). Div. Materiaux et Structures.

FATIGUE SAFETY FACTOR: ASSESSMENT OF ASSOCIATED SAFETY LEVEL

V. DEHAYE /in AGARD, Fatigue Management 5 p Dec. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A03

Techniques related to the determination of fatigue reliability factors for aircraft structures are discussed. Particular attention is given to methods for the estimation of corresponding safety levels. Of central concern are those combat aircraft that have been reviewed according to the 'safe life' concept. The parameters affecting structural fatigue behavior are outlined. Approaches to fatigue reliability analysis used for the principle french combat fleet are addressed. Transl. by M.G.

N92-20909# Rolls-Royce Ltd., Derby (England).

THE ROLE OF CRACK GROWTH IN DEFECT ASSESSMENT

JOHN ROCHE and CHRIS HOWLAND Nov. 1990 7 p (PNR-90798; ETN-92-90772) Copyright Avail: CASI HC A02/MF A01

The gas turbine industry is around fifty years old. The technology of the industry has evolved under the twin impulses of safety and direct operating cost. Since safety should not be compromised, (there are rules to ensure it is not) an assessment of material properties becomes essential. One such property is that of crack growth, and this is often referred to generically as 'defect tolerance'. The components concerned are normally those which rotate, and in the event of failure could cause a significant risk to the aircraft and its passengers. Assessment of a compressor or turbine disc is a multidisciplinary method. Here it is viewed from the perspective of the measurement of crack rates. The nucleation of a crack, the measurement of small crack growth rates, the measurements of large crack growth rates and fast fracture, and the four components of total life, are discussed. ESA

N92-28643# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

SPACECRAFT SUSTAINED LOAD FRACTURE CONTROL

R. J. H. WANHILL 10 May 1989 89 p

(Contract ESA-A0/2-1162-NL/PH)

(NLR-TP-89163-U; ETN-92-91521) Avail: CASI HC A05/MF A01

The opportunities for sustained load fracture control in spacecraft are indicated. Emphasis is given to verification by small scale laboratory testing. Sustained load fracture must be eliminated or controlled in service. For this purpose, a comprehensive fracture control plan is outlined. Materials and environments in aerospace structures and systems are considered and stress corrosion cracking, hydrogen embrittlement, and liquid metal embrittlement are discussed as major sustained load fracture. The laboratory testing is defined and placed in categories of major importance which provides the plans for preparing detailed test plans and proposals to systematically investigate the various categories of materials, environments, and types of test. ESA

N92-28650# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

CORRELATION, ERROR-LOCALISATION, AND UPDATING OF THE SECOND PROBLEM DEFINED IN GARTEUR AG11

A. DEBOER and M. H. W. ELLENBROEK 12 Feb. 1990 28 p (Contract NIVR-02904-N)

(NLR-TP-90070-U; ETN-92-91433) Avail: CASI HC A03/MF A01

A clamped free truss structure problem, defined in the GARTEUR (Group for Aeronautical Research and Technology in Europe) Action Group 11 refinement of structure dynamics computational methods, is described. The measured and calculated

modal data of the structure are correlated, the locations of the errors are determined, and the finite element model of the structure is updated. These analyses are performed with the B2000 validation processor and the program TANCO. ESA

N92-28850# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

CRACK RESISTANCE, FRACTURE TOUGHNESS AND INSTABILITY IN DAMAGE TOLERANT Al-Li ALLOYS

R. J. H. WANHILL, L. SCHRA, and W. G. J. THART 10 May 1990 29 p Presented at ASTM Symposium on Cyclic Deformation Fracture, and Nondestructive Evaluation of Advanced Materials, San Antonio, TX, Nov. 1990

(NLR-TP-90172-U; ETN-92-91538) Avail: CASI HC A03/MF A01

A comparison of the crack resistance (R curve), fracture toughness and instability behavior of candidate damage tolerant aluminum lithium alloys, 2091 and 8090, and the widely used conventional 2024-T3 alloy is addressed. The 2091 alloy was in three heat treatment conditions, T8X, TX and TY, all artificially aged. The 8090 alloy was in the T81 condition. The crack resistances and fracture toughnesses of 2091-T8X and 8091-T81 were similar to those of 2024-T3, but at a 50 MPa lower strength level. The crack resistances and fracture toughnesses of 2091-TX and 2091-TY were much inferior. In all cases, stable (slow) crack growth was ductile, but unstable crack growth in 2091-TX and 2091-TY was 100 percent intergranular and macroscopically brittle. Unstable crack growth in 2091-T8X was 50 percent intergranular and macroscopically ductile. Fractographic analysis indicated the 2091-TX and 2091-TY alloys to be sensitive to dynamic effects, such that the dynamic fracture toughness could be significantly lower than the quasistatic fracture toughness. This may also be true of 2091-T8X. These results point out that fail safe crack arrest tests should be included in any evaluation of damage tolerant Al-Li sheet alloys for aircraft structures. ESA

N92-29603# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

SHORT CRACKS AND DURABILITY ANALYSIS OF THE FOKKER 100 WING/FUSELAGE STRUCTURE

R. J. H. WANHILL and L. SCHRA 2 Oct. 1990 24 p Presented at the International Conference on Short Cracks, Sheffield, England, Dec. 1990

(NLR-TP-90336-U; ETN-92-91449) Avail: CASI HC A03/MF A01

Short and long fatigue crack growth in the industry standard damage tolerant aluminum alloy 2024-T3 were compared using flight simulation leading representative for the Fokker 100 wing/fuselage structure. The results and a straightforward durability analysis showed that the behavior of short cracks is not significant for the current wing/fuselage structure. The data provide a reference for evaluating new candidate materials for durable wing/fuselage structures in transport aircraft. ESA

N92-30423# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Aircraft Div.

MBB-LAGRANGE: A GENERAL STRUCTURAL RELIABILITY AND OPTIMIZATION STRUCTURAL SYSTEM

RAINER ZOTEMANTEL 6 Sep. 1991 21 p Presented at the IFIP Conference, Munich, Fed. Republic of Germany, 11-13 Sep. 1991 Repr. from Reliability and Optimization of Structural Systems 2 (R. Rackwitz u P. Thoft-Christensen) 1991

(MBB/FW321/S/PUB/467; ETN-92-91901) Copyright Avail: CASI HC A03/MF A01

MBB-LAGRANGE is a program system which allows the optimization of general structural systems. The geometry and properties of these structures are idealized by a finite element model with isotropic, orthotropic, anisotropic and composite materials. The design variables and a variety of constraints characterize the optimization model. The design variables are element thicknesses, cross sections, concentrated masses and fiber angles. The design can be restricted with respect to statics (e.g., stresses, displacements), dynamics (natural frequencies, dynamic response) and aeroelastics (efficiencies, flutter speed). In general the aim is to minimize the structure weight subject to

the constraints. But often it is necessary to get only a feasible design. The highlights of the program system are: simultaneous optimization, a wide range of mathematical programming algorithms, a modular architecture within computer aided engineering environment. A lot of large scale problems, especially space and aircraft structures, demonstrate the power of MBB-LAGRANGE. ESA

N92-33139*# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

GLOBAL/LOCAL INTERLAMINAR STRESS ANALYSIS OF A GRID-STIFFENED COMPOSITE PANEL

J. F. M. WIGGENRAAD and N. R. BAULD, JR. (Clemson Univ., SC.) 30 May 1991 21 p Presented at the 6th American Society for Composites Technical Conference, Albany, NY, 6-9 Oct. 1991

(Contract NAS1-17925)

(NASA-CR-190822; NAS 1.26:190822; NLR-TP-91052-U;

ETN-92-91996) Avail: CASI HC A03/MF A01

A global/local procedure for the computation of the interlaminar stress components at the skin wrap, skin core, and wrap core interfaces for an advanced concept stiffened panel, is described. The procedure consists of a global model of two dimensional shell elements that is used to design a grid stiffened panel with blade type stiffeners, a local model of three dimensional solid elements that is used to compute interlaminar stress components, and a scheme devised to assign displacement boundary conditions for a local model that are based on displacement and rotation data of a few nodes of the global model. A global panel was designed according to strength, stiffness, and stability criteria associated with the design of traditional aircraft wing panels. Interlaminar normal and shearing stress components, computed via the local model, were found to be well below typical tensile normal and shearing strengths of a graphite epoxy material. ESA

N92-71104 Birmingham Univ. (England).

SYMPOSIUM ON DYNAMIC BALANCING

Avery (W. and T.), Ltd. 30 Dec. 1964 52 p Symposium held in Birmingham, England, Mar. 1964; Sponsored by Avery (W. and T.), Ltd.

Avail: CASI HC A04

A collection of six conference papers on the subjects of vibration and dynamic balancing are presented. They include the effect of vibration due to rotating unbalance in machinery, gas turbine engine rotor balance and vibrations, balancing machine instrumentation, dynamic balancing of aircraft gyroscopes, looking to the future in balancing, and balancing in the motor car plant. J.P.S.

43

EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

A92-17104

APPLICATION OF AIRCRAFT MULTISPECTRAL SCANNER DATA TO ALGAE MAPPING OVER THE VENICE LAGOON

G. ZIBORDI, F. PARMIGGIANI (CNR, Istituto per lo Studio delle Metodologie Geofisiche Ambientali, Modena, Italy), and L. ALBEROTANZA (CNR, Istituto per lo Studio della Dinamica delle Grandi Masse, Venice, Italy) Remote Sensing of Environment (ISSN 0034-4257), vol. 34, Oct. 1990, p. 49-54. refs

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Atmospheric and vegetation-index calculations based on multispectral scanner data are presented to demonstrate the effectiveness of the technique for monitoring and mapping algae in the upper layers of water. The techniques are described including the theoretical bases of atmospheric correction, classification based

43 EARTH RESOURCES AND REMOTE SENSING

on the normalized-difference vegetation index (NDVI), and the masking of land elements. The results indicate that the NDVI classifier can be corrected to apply the airborne TM data to effective estimates of algae data for mapping and collection. C.C.S.

A92-17124

SPECTRAL EMISSIVITY VARIATIONS OBSERVED IN AIRBORNE SURFACE TEMPERATURE MEASUREMENTS

T. J. SCHMUGGE (USDA, Hydrology Laboratory, Beltsville, MD), F. BECKER, and ZHAO-LIANG LI (Groupeement Scientifique de Teledetection Spatiale, Strasbourg, France) (Beltsville Symposium on Remote Sensing for Agriculture, 15th, Beltsville, MD, May 16-18, 1990, Proceedings. A92-17122 04-43) Remote Sensing of Environment (ISSN 0034-4257), vol. 35, Feb.-Mar. 1991, p. 95-104. refs

Copyright

The Thermal Infrared Multispectral Scanner (TIMS) was flown on the NASA C-130 aircraft for a series of 12 flights during the HAPEX experiment in the Southwest of France during 1986. TIMS provides coverage of the 8-12 micron thermal infrared band in six contiguous channels so that it is possible to observe the spectral behavior of the surface emissivity over this wavelength interval. The surfaces observed ranged from bare soils to coniferous forest. As expected, the fully vegetated fields, a small lake, and a coniferous forest exhibited little or no spectral variation. However, the bare soil surfaces had a 5-10 C difference in radiant temperature over the TIMS channels with the three shorter wavelength channels having lower temperatures than the three longest wavelength channels. This spectral variation arises from the absorption of infrared radiation due to the stretching vibrations of the silicon-oxygen bonds of silicates in the soil. These results indicate that the longer wavelength channels in the 8-12 micron band may be preferable for surface temperature sensing for soils rich in silicates. Author

A92-27231

PASSIVE MICROWAVE REMOTE SENSING OF SOIL MOISTURE FROM AIRCRAFT IN HUNGARY

G. IJJAS (Budapest, Technical University, Hungary) and Y. S. RAO (Indian Institute of Technology, Bombay, India) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, Feb. 1992, p. 471-479. Research supported by Hungarian Academy of Sciences, Ministry of Agriculture, and State Office of Technical Development. refs

Copyright

Experimental flight measurements were carried out in Hungary on 14 October 1988 to check the performance of the airborne microwave L-band radiometer system developed by the Space Research Group, Technical University of Budapest, for the determination of soil moisture. The results of the aircraft measurements at two different altitudes are presented. The relation between soil moisture and emissivity predicted by different dielectric models are used to estimate soil moisture. The estimated soil moisture is compared with limited ground truth soil moisture taken synchronously with flight measurements. Soil moisture and topographic maps are presented for quick-look observation of soil moisture against agricultural fields. Author

A92-34903

FIRST RESULTS FROM THE NETHERLANDS SAR TESTBED 'PHARS'

P. HOOGEBOOM, P. KOOMEN (TNO, The Hague, Netherlands), H. POUWELS (National Aerospace Laboratory, Amsterdam, Netherlands), and P. SNOEIJ (Delft University of Technology, Netherlands) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 241-244. refs

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The PHARUS (phased array universal synthetic aperture radar) project is a plan to design and build a polarimetric C-band aircraft synthetic aperture radar (SAR) system of a novel design. The system will make use of a phased-array antenna with solid-state

43 EARTH RESOURCES AND REMOTE SENSING

amplifiers. The first step in the PHARUS project was the realization of PHARS, an SAR testbed at C-band, which made its first test flights in 1990. The testbed is based on the concept of a wide beamwidth antenna, rigidly fixed to the aircraft. Pulse compression and a high PRF (3500 Hz) ensure sufficient sensitivity in this system, which is equipped with a 160-W peak pulse solid-state transmitter. The authors focus on the SAR system and on the results obtained from the first test flights. A performance evaluation of the system using corner reflectors was part of the test program. I.E.

A92-35007

BULGARIAN EFFORT TOWARD THE OPERATIONAL USE OF PASSIVE MICROWAVE REMOTE SENSING OF SOIL MOISTURE

K. G. KOSTOV, M. A. MIKHALEV, N. M. NEDELICHEV, A. IA. SPASOV, B. I. VICHEV (Bulgarian Academy of Sciences, Institute of Electronics, Sofia, Bulgaria), S. G. GAIDAROVA, and D. D. DAVIDOV (Bulgarian Academy of Sciences, Institute for Hydrotechnique and Amelioration, Sofia, Bulgaria) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 761-764. Research sponsored by Ministry of Agriculture of Bulgaria. refs

Copyright
The main results of a program for remote sensing of soil moisture implemented in Bulgaria during the period 1987-1989 are given. The hardware developed (an airborne system consisting of L-band microwave radiometers and a microcomputer-based data acquisition and processing unit) has proven to be reliable on board the aircraft and can be used for soil moisture monitoring and mapping. Under spring conditions, the accuracy of the technique used is high enough for estimation of the preplanting soil moisture content in the top 1-m layer. I.E.

A92-35034

RADIOMETRIC OBSERVATIONS AT 89 AND 157 GHZ OF ATMOSPHERIC AND SURFACE PROPERTIES MEASURED FROM AN AIRCRAFT

S. J. ENGLISH (Oxford, University, England), J. S. FOOT, D. C. JONES, S. J. STRINGER, B. GREENER (Meteorological Office, Farnborough, England), P. ENCRENAZ (Meudon, Observatoire, France), A. CHEDIN, N. A. SCOTT, C. CLAUD, F. SIROU (CNRS, Laboratoire de Meteorologie Dynamique, Palaiseau, France) et al. IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 895-898. refs

Copyright
An aircraft radiometer measuring upward and downward brightness temperatures at 89 and 157 GHz is described. Initial results from two large international experiments are presented showing some comparisons with models of water vapor continuum emission, sea surface emission and cloud emission. Initial comparisons with empirical models have been very encouraging. Although developed and tested for lower frequencies the results analyzed higher frequencies to a reasonable accuracy. I.E.

A92-35173

MULTI-PARAMETER AIRBORNE SAR EXPERIMENTS AT AN ALPINE TEST SITE

HELMUT ROTT (Innsbruck, Universitaet, Austria) and ROBERT E. DAVIS (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1563-1566. Research supported by Oesterreichische Akademie der Wissenschaften. refs

(Contract FFWF PROJECT S-3801)
Copyright
The high Alpine test site Oetzal in the Central Alps of Austria

was surveyed by the three-frequency (P-, L-, C-band) polarimetric SAR (synthetic aperture radar) of JPL onboard the NASA DC-8 in August 1989 and by the E-SAR of the German Aerospace Research Establishment in July 1990. The E-SAR was mounted on a small twin-engined aircraft and operated alternately in the x-band and the C-band, HH polarizations, on successive overflights. This data set is the basis for development of data analysis algorithms and application studies in snow hydrology, glaciology, and geomorphology, and for the development of radargrammetric methods in complex terrain. Characteristic polarization signatures have been identified for the main surface types, such as snow, glacier ice, and ground moraine, revealing significant potential for target discrimination. In the case of unpolarized SAR, C- and X-band frequencies permit clear separation of snow cover, glacier ice, and ice-free surfaces. Due to differences in the frequency behavior of backscattering, dual-frequency SAR data are very useful for classification of these targets. I.E.

A92-35302

MULTISENSOR, MULTIFREQUENCY, MULTITEMPORAL AIRCRAFT MICROWAVE MEASUREMENTS OVER AGRICULTURAL FIELDS

P. FERRAZZOLI (Roma II, Universita, Rome, Italy), S. PALOSCIA, P. PAMPALONI (CNR, Istituto di Ricerca sulle Onde Elettromagnetiche, Florence, Italy), G. SCHIAVON, and D. SOLIMINI (Roma II, Universita, Rome, Italy) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 2261-2264. Research supported by ASI. refs

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A92-37154

THE FRENCH SPACE PROGRAM FOR EARTH OBSERVATION [LE PROGRAMME SPATIAL FRANCAIS POUR L'OBSERVATION DE LA TERRE]

A. BAUDOIN and M. CHEVREL (CNES, Division Observation de la Terre, Paris, France) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, no. 6-7, Apr.-May 10, 1992, p. 1083-1101. In French. refs

Copyright
After a short presentation of the ocean and atmosphere observation programs, the paper describes the first French experiments on earth resources remote sensing with the American satellites Landsat, Seasat, etc. Subsequently the SPOT program is reviewed. The first satellite, SPOT 1, was launched on 22 February 1986. With its high resolution sensors (10-20 m) and side-looking capabilities, SPOT gives images for many operational applications (cartography, renewable resources, etc.). Author

A92-37633

CHARACTERIZATION OF ACTIVE FIRES IN WEST AFRICAN SAVANNAS BY ANALYSIS OF SATELLITE DATA - LANDSAT THEMATIC MAPPER

JEAN M. BRUSTET, JEAN B. VICKOS, JACQUES FONTAN (Toulouse III, Universite, France), ALAIN PODAIRE, and FRANCOIS LAVENU (Laboratoire d'Etudes et de Recherches en Teledetection Spatiale, Toulouse, France) IN: Global biomass burning Atmospheric, climatic, and biospheric implications. Cambridge, MA, MIT Press, 1991, p. 53-60.

Copyright
The mid-IR channels of the high resolution remote sensing satellite, Landsat 5, are highly suited to the characterization of biomass burning (BMB) events, as presently illustrated in the case of northeastern Ivory Coast. It is noted, however, that the surface area thus determined to be burning is exaggerated by an artificial enlargement of the BMB fire-front width, and that it is difficult to estimate the temperature of the areas that lie behind the fire front (having very recently been burned). Aircraft remote sensing may be required for more accurate monitoring of active savanna fires. O.C.

A92-44167**THE UK ELEMENT OF THE MAESTRO-1 SAR CAMPAIGN**

J. R. BAKER (British National Space Centre, Huntingdon, England) and P. L. MITCHELL (Cambridge, University, England) (Remote Sensing Society, Workshop on Relating SAR to Surface Data-Measurements, Maps and Models, Sheffield, England, Apr. 4, 1990) *International Journal of Remote Sensing* (ISSN 0143-1161), vol. 13, no. 9, June 1992, p. 1593-1608. Research supported by ESA, CEC, British National Space Centre, and Royal Aircraft Establishment. refs

Copyright

As part of a campaign organized by ESA and the Joint Research Centre Ispra, two sorties of the NASA DC-8 aircraft took place during August 1989 over three East Anglian test sites. The aircraft was equipped with the Jet Propulsion Laboratory P-/L-/C-band SAR and the characteristics of the radar are outlined and the associated calibration campaign described. An extensive ground data collection campaign was undertaken by a series of UK groups for forestry, agricultural and hydrological applications. The collection of forestry ground data is described in some detail. The anticipated uses of the ground data in the analysis of the radar images helped to determine the strategy for the selection of parameters to be measured.

Author

N92-11404# Rijkswaterstaat, Delft (Netherlands). Survey Dept.
COMPARISON OF IN SITU, AIRCRAFT- AND SATELLITE-DERIVED SURFACE REFLECTANCES IN FLEVOLAND (NETHERLANDS)

J. M. M. KOKKE *In* ESA, Physical Measurements and Signatures in Remote Sensing, Volume 1 p 57-60 May 1991 Sponsored in part by Begleidingscommissie Remote Sensing Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A validation campaign set up in one of the Dutch polders to evaluate a complete atmospheric correction method for multispectral satellite borne imagery is reported. A ground based radiometer measured total and diffuse spectral irradiance simultaneous with Thematic Mapper data acquisition for purposes of atmospheric correction of observed satellite radiances. The experiment included the use of data of the Dutch airborne scanner CAESAR to compare measured reflectances from several altitude levels. To assess the surface reflectance factors in the test area, a hand held field radiometer was used. Reference panels with known reflectances served for calibration of in situ and airborne data. Differences between satellite derived reflectances and ground based reflectances were quite small. Somewhat larger deviations occurred in airborne derived reflectances, which could not accurately be explained because of insufficient knowledge of some instrumental factors, e.g., field radiometer spectral response.

ESA

N92-11412# Centre National de Recherches Meteorologiques, Toulouse (France).

TIMS CALIBRATION CORRECTION BY COMPARISON WITH PRT5

MAGALI STOLL, THIERRY PHULPIN, and THOMAS SCHMUGGE (Agricultural Research Service, Beltsville, MD.) *In* ESA, Physical Measurements and Signatures in Remote Sensing, Volume 1 p 89-93 May 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

An analysis of the data acquired by TIMS (Thermal Infrared Multispectral Scanner) operating from the NASA C-130 during HAPEX (Hydrologic Atmospheric Experiment) showed systematic errors in brightness temperatures for all 6 channels with a magnitude depending on the aircraft altitude. The TIMS correction depends on estimating the actual temperatures of the cold (Tc) and hot (Th) blackbody references. The TIMS data is compared with those obtained by the broadband nonscanning PRT5 by using a method of maximum correlation between corresponding radiances. The correlations were always greater than 0.92. To correct the TIMS calibration, a relation between TIMS surface brightness temperatures, Ti, and PRT5 surface brightness

temperature, T, taking into account emissivities variations was used. Tc and Th are deduced from the slope and origin of the regression between corresponding surface brightness temperatures. The final accuracy on brightness temperatures varies from 0.3 to 1.3 degrees.

ESA

N92-11471# Lille-1 Univ., Villeneuve-d'Asoq (France). Lab. d'Optique Atmospherique.

AIRCRAFT SIMULATIONS OF THE POLDER EXPERIMENT: FIRST RESULTS

J.-L. DEUZE, JEAN-YVES BALOIS, C. DEVAUX, L. GONZALEZ, M. HERMAN, P. LECOMTE, and CHRISTIAN VERWARDE *In* ESA, Physical Measurements and Signatures in Remote Sensing, Volume 1 p 393-396 May 1991 Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The POLDER (Polarization and Directionality of the Earth's Reflectances) instrument is a new device designed to measure from space, with different viewing angles, the reflectance and polarization of the solar radiation, reflected by the Earth atmosphere system, at visible and near infrared wavelengths. Measurements performed in June 1990 during the first aircraft experimentation of the POLDER simulator, over the region of La Crau (south east of France) are presented.

ESA

N92-11506# Institut National de la Recherche Agronomique, Thiverval-Grignon (France). Station de Bioclimatologie.

USING THE RADIATIVE SURFACE TEMPERATURE IN ENERGY BUDGET STUDIES OVER PLANT CANOPIES

YVES BRUNET (California Univ., Davis.), KYAW THA PAWU (California Univ., Davis.), and LAURENT PREVOT *In* ESA, Physical Measurements and Signatures in Remote Sensing, Volume 2 p 557-560 May 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The infrared surface temperature has been extensively used over the past few years in the determination of the energy balance of plant canopies. However, the surface temperature required by turbulent transfer equations is a priori defined from purely aerodynamic considerations. It is therefore of importance to investigate the differences between these two surface temperatures, in order to use correctly the radiative temperature in flux calculations. For this purpose, simulations were performed with a multilayer higher order closure model describing the radiative and turbulent processes within and above a plant canopy, for given climatic conditions and various canopy structures. The radiative temperature values calculated for all azimuth and zenith angles of the sensor are presented. The differences obtained between radiative and aerodynamic temperatures are interpreted in terms of an excess resistance. The consequences on the possible heat flux calculation are discussed.

ESA

N92-11535# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. for Optoelectronics.

CO2 LASER ACTIVE REMOTE SENSING FROM 9 TO 11 MICRONS: AIRBORNE AND LABORATORY APPLICATION

P. HAUSKNECHT and L. B. WHITBOURN (Commonwealth Scientific and Industrial Research Organization, Linfield, Australia) *In* ESA, Physical Measurements and Signatures in Remote Sensing, Volume 2 p 697-701 May 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

An active airborne remote sensing system using a rapidly tuned CO2 laser, which covers the region between 9.2 and 11.1 microns with up to 90 lines of different wavelengths is reported. The system was designed to produce a contiguous line profile with 2 m diameter footprints at a range of 500 m and an aircraft speed of 80 m/s. Results of airborne tests are presented. The first series was performed in October 1989 in south east New South Wales (Australia). These data sets show recognizable spectral reflectance signatures over a number of sites. The second series was carried out in Oct. 1990 in Western Australia and the data show an

43 EARTH RESOURCES AND REMOTE SENSING

improved signal to noise ratio and data quality. The acquired profiles of ground spectra are very promising, and good results are expected after a more detailed analysis. ESA

N92-23381# Oldenburg Univ. (Germany).

INTRODUCTION: OCEAN AIR OBSERVATION [EINLEITUNG: LUFTUEBERWACHUNG DER SEE]

R. REUTER *In* MBB, Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 6 p May 1991 In GERMAN

Avail: CASI HC A02/MF A04

It is shown that coastal waters are to be considered as important regions for oceanographic remote sensing, and that aircraft are particularly suitable for remote sensing, on account of lower costs, with regard to satellite remote sensing. A short review of aircraft remote sensing development status is given. ESA

N92-23383# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

RECOMMENDED SYSTEM CONCEPT [VORGESCHLAGENES SYSTEMKONZEPT]

C. BOESSWETTER *In* its Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 4 p May 1991 In GERMAN

Avail: CASI HC A01/MF A04

It is shown that microwave sensors are mainly used for the detection and measurement of surface effects, and that only a multispectral measurement system with several independent sensor principles is able to give a unique interpretation of the phenomena. Such a system is not currently available, either in Germany or in Europe. It should include modular instrumentation on different carrier aircraft, possibilities of integration of sensor systems from the European Euromar countries by standardization, optoelectronic and microwave sensors, and distribution of multisensor data in all interested institutions of Euromar countries. ESA

N92-23389# Oldenburg Univ. (Germany).

SEABORNE LIDAR SYSTEM [SCHIFFSGESTUETZTES LIDAR-SYSTEM]

R. REUTER *In* MBB, Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 9 p May 1991 In GERMAN

Avail: CASI HC A02/MF A04

The theoretical background is described. It is shown that an interpretation of lidar data is essentially carried out, using the hydrographic lidar equation. The seaborne lidar allows measurement with depth probes. The disturbing daylight background is much weaker when using the ship rather than aircraft system because there is no reflection of sunlight from the water surface and the measurement can take place in the shadow of the hull. The selection of excitation wavelengths and detection channels is described. The technical data are summarized. ESA

N92-23392# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

PASSIVE OPTICAL AND IR SENSORS [PASSIVE OPTISCHE UND IR-SENSOREN]

H.-D. V. BOEHM and H. BEHRMANN *In* its Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 35 p May 1991 In GERMAN

(MBB-UH-HE512) Avail: CASI HC A03/MF A04

Forward Looking Infrared (FLIR) sensors are shown to detect the thermal radiation in the medium and far infrared. Passive optical instruments may be added to other sensors to serve as quick look and for archiving purposes. They can help to identify ships causing pollution. Ordinary video cameras with Charge Coupled Device (CCD) are used in normal daylight. At night, Low Level Television (LLTV) cameras with image intensification capability based in Micro Channel Plate (MCP) technology with CCD are used for operation in an aircraft. A FLIR detects the thermal radiation of the object surface and generates images which can

be interpreted by the human eye. The main parameters for state-of-the-art systems are given. ESA

N92-23393# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

QUICK-LOOK SYSTEM [QUICK-LOOK SYSTEM]

P. HICKS *In* its Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 16 p May 1991 In GERMAN

Avail: CASI HC A03/MF A04

The requirements of the quick look system on board the measuring aircraft are described. Recommendations for the implementation of such a system are given. The functions of the quick look system are presented: sensor checking, sensor mode, control of the flight path, and first collection of measuring results. ESA

N92-23402# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

PRECONSIDERATIONS ON AIRCRAFT INTEGRATION [VORUEBERLEGUNGEN ZUR FLUGZEUG-INTEGRATION]

H. FINKENZELLER *In* MBB, Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 14 p May 1991 In GERMAN

Avail: CASI HC A01/MF A04

Preconsiderations were envisaged in the integration of the various sensors and subsystems in the aircraft belonging to the German air and space institution. These preconsiderations could not be carried out because of lack of cooperation in the definition phase. The assembly configuration for the DO 228 LM aircraft is shown as an example. ESA

N92-23403# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

SENSOR COMPATIBILITY/OPTIMAL SENSOR COMBINATIONS [SENSOR-VERTRAEGlichkeit/OPTIMALE SENSOR-KOMBINATIONEN]

C. BOESSWETTER *In* its Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 2 p May 1991 In GERMAN

Avail: CASI HC A01/MF A04

It is shown that the sensors considered scan extraordinary wide bandwidth. They cover practically the whole electromagnetic spectrum which is significant for the examination of ocean situation. Sensor compatibility is examined using examples such as the reaction of pilot radiotelephony on simultaneously operating radar or microwave radiometer system. The influence of sensors on the propagation path can be neglected. The most important restrictions result from the limited payload capacity and power consumption of all aircraft carriers considered. ESA

N92-23407# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

NATIONAL USER INTERFACES [SCHNITTSTELLE ZU NATIONALEN NUTZERN]

C. BOESSWETTER *In* its Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 4 p May 1991 In GERMAN

Avail: CASI HC A01/MF A04

Investigations have shown that Euromar-Seastars potential users represent a very heterogeneous group. All currently available national potential user information was examined in a definition study. The potential national users were given a questionnaire and were asked to respond. ESA

N92-23925# Centre National d'Etudes Spatiales, Toulouse (France). Groupe de Recherche de Geodesie Spatiale.

GRAVITY FIELD DATA PRODUCTS FROM THE ARISTOTELES MISSION

GEORGES BALMINO *In* ESA, The Solid-Earth Mission Aristoteles p 111-113 Dec. 1991

Avail: CASI HC A01/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

The Aristoteles mission will bring a wealth of homogeneous information about the Earth gravity field enabling new direct and inverse modeling of geophysical structures at various scales. A reference geoid surface quality will help in oceanographic studies, leading to global models (in spherical harmonics) of high resolution for versatile applications and precise orbit determination of artificial satellites (especially those of altimetric missions). The basic data coming from the microaccelerometers which compose the gradiometer will, in addition to gravity gradients, provide information on the surface forces acting on the spacecraft including the atmospheric drag, from which density models will be improved. The different types of measurements involved in these investigations, the various levels of processing and how they can be phased with the scientific activities, and the expected products are discussed. General schemes are proposed along which the different tasks can be undertaken. ESA

N92-26337# Hamburg Univ. (Germany). Inst. fuer Meteorologie.

INVESTIGATION OF CONVECTION OVER SEA BY AIRCRAFT OBSERVATIONS [FLUGZEUGMESSUNGEN ZUR KONVEKTION UEBER SEE]

HANS HINZPETER /in DLR, Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 71-86 Sep. 1991 In GERMAN; ENGLISH summary Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Results of aircraft observations over the North Sea and the Greenland Sea are given. Their interpretation by different numerical models is discussed. It is shown that the model results depend on the parameterization of the vertical exchange, and that the development of open cells is still not understood. ESA

N92-29688# Beleidscommissie Remote Sensing, Delft (Netherlands).

ACTIVITIES REPORT OF THE NETHERLANDS REMOTE SENSING BOARD (WITH ABRIDGED VERSION) Annual Report, 1990

1991 140 p In DUTCH

(ETN-92-91352) Avail: CASI HC A07/MF A02

The main activities carried out by the Netherlands Remote Sensing Board within the executional limits of the Dutch National Remote Sensing Program are overviewed. This five year program proceeded along the guidelines of its four basic objectives: to prepare operational remote sensing techniques, and put them on a viable commercial basis; to prepare for the ERS-1 project; to apply remote sensing for the benefit of developing countries to build up and extend the Dutch remote sensing user community by constructing and developing the proper national infrastructure for this purpose. ESA

N92-29707# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

CAESAR: A CCD AIRBORNE EXPERIMENTAL SCANNER FOR APPLICATIONS IN REMOTE SENSING RADIOMETRIC AND GEOMETRIC CALIBRATION

W. J. LOOYEN and R. W. VANSWOL 14 Mar. 1989 30 p (NLR-TP-89103-U; ETN-92-91517) Avail: CASI HC A03/MF A01

The project concerning a multispectral scanner named, CAESAR, Charge Couple Device (CCD) Airborne Experimental Scanner for Application in Remote Sensing is presented. The objectives of the project were to increase technical knowledge of and practical experience with the application of linear CCD detectors in remote sensing for land and sea observation. With this scanner two objectives were fulfilled: technical knowledge about CCD detectors and practical experience with their application in remote sensing were gained and an important research tool was made available to remote sensing scientists. CAESAR was designed to make land and sea (water) observations in up to nine different wavelength bands. The application of CCD arrays in CAESAR required radiometric calibration of all individual CCD elements in order to meet the important user requirements on the minimum detectable ground reflectance variation. Since CAESAR

is an airborne scanner geometric corrections are required, as well, to compensate for image distortions due to aircraft motions. Both radiometric and geometric corrections are applied during the preprocessing of the data. The results of performance tests show that the design goals were met and that an advanced airborne scanner for land and marine applications can be offered to the remote sensing community. ESA

N92-30230# Beleidscommissie Remote Sensing, Delft (Netherlands).

COMPARISON OF IN SITU, AIRCRAFT- AND SATELLITE DERIVED SURFACE REFLECTANCES IN FLEVOLAND (NETHERLANDS). A VALIDATION EXPERIMENT

J. M. M. KOKKE (Rijkswaterstaat, Delft, Netherlands) Nov. 1991 34 p

(Contract BCRS PROJ. IS-3.9)

(BCRS-91-28; ISBN-90-5411-010-4; ETN-92-91877) Avail: CASI HC A03/MF A01

In order to evaluate a complete atmospheric correction method for multispectral spaceborne imagery, a validation campaign was set up in one of the Dutch polders. A ground based radiometer measured total and diffuse spectral irradiance simultaneous with Thematic Mapper (TM) data acquisition for purposes of atmospheric correction of observed satellite radiances. The experiment included the use of data of the Dutch CAESAR (CCD (Charge Coupled Device) Airborne Experimental Scanner) to compare measured reflectances from several altitude levels. To assess the surface reflectance factors in the test area, a hand held field radiometer was used. Reference panels with known reflectances served for calibration of in situ and airborne data. Differences between satellite derived reflectances and ground based reflectances were quite small. Somewhat larger deviations occurred in airborne derived reflectances, which could not accurately be explained because of insufficient knowledge of some instrumental factors, e.g., field radiometer spectral response. ESA

N92-33691# Technische Univ., Berlin (Germany). Fachgebiet Photogrammetrie und Kartographie.

EXAMINATION AND MAPPING OF FOREST DAMAGE USING REMOTE SENSING METHODS Final Report [DIGITALE GEOMETRISCHE AUFBEREITUNG MULTISENSORALER UND MULTITEMPORALER FERNERKUNDUNGSDATEN FUER DIE WALDSCHADENSFORSCHUNG]

JOSEF BRAUERS, WOLFGANG HARTERMANN, and FRANK SCHOLTEN Mar. 1991 79 p In GERMAN

(Contract BMFT-0339048-A)

(ETN-92-91913) Avail: CASI HC A05/MF A01

The geometrical processing of remote sensing data was examined. Application directrices were established. Specific methods for the processing of data from the various recording systems, e.g., aerial photographs, aircraft scanners, satellite video data, were developed. All methods were transformed into software modules and made available for further routine applications. The various program systems are working with standardized data structures, so that a communication of the single systems to one another is possible over the common interfaces, for instance control point data. Processes for the compensation of digitalized aerial photographs were developed. ESA

ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

A92-40401

SPS 91 - POWER FROM SPACE; PROCEEDINGS OF THE 2ND INTERNATIONAL SYMPOSIUM, ECOLE SUPERIEURE D'ELECTRICITE, GIF-SUR-YVETTE, FRANCE, AUG. 27-30, 1991

Symposium supported by Alenia Spazio S.p.A., CNRS, AIAA, et al. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, 641 p. In English and French. For individual items see A92-40402 to A92-40408, A92-40410 to A92-40422, A92-20424 to A92-40461, A92-40463 to A92-40481, A92-40483 to A92-40487.

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Various papers on the concept of Solar Power Satellites (SPS) are presented. The general topics addressed include: global energy issues; SPS demonstration projects; extraterrestrial materials; power generation, conversion, and storage; environmental issues; development strategies. C.D.

ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

A92-16108

ENVIRONMENTAL IMPACT OF A FUTURE SUPERSONIC TRANSPORT AIRCRAFT [IMPACT SUR L'ENVIRONNEMENT D'UN FUTUR AVION DE TRANSPORT SUPERSONIQUE]

ANDRE GIRARD (ONERA, Direction de la Physique, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 148-149, 1991, p. 37-44) ONERA, TP no. 1991-132, 1991, 9 p. In French. refs (ONERA, TP NO. 1991-132)

A study is presented on the environmental impact of sonic booms and the effects of NO(x) on the ozone layer. It has been established that an increase of tropospheric ozone concentration is a consequence of an increase in NO(x) injection. At 19 km and higher, injected NO(x) lowers the ozone column. This ozone destruction increases quickly with the altitude of NO(x) injection, at least to 25 km. In addition, attention is given to techniques that might be employed to reduce or negate the effects of the sonic boom in various areas of the environment. R.E.P.

A92-19193

IMPACT OF AIRCRAFT AND SURFACE EMISSIONS OF NITROGEN OXIDES ON TROPOSPHERIC OZONE AND GLOBAL WARMING

COLIN JOHNSON, JIM HENSHAW (Harwell Laboratory, Didcot, England), and GORDON MCINNES (Warren Spring Laboratory, Stevenage, England) Nature (ISSN 0028-0836), vol. 355, Jan. 2, 1992, p. 69-71. Research supported by CEC and Department of Environment of England. refs

Copyright

Tropospheric ozone, in addition to being toxic to living organisms, is a greenhouse gas. Radiative forcing of surface temperature is most sensitive to tropospheric ozone changes at about 12-km altitude, where aircraft NO(x) emissions are greatest and ozone model sensitivity to NO(x) is enhanced. The present model indicates that radiative forcing of surface temperature is of the order of 30 times more sensitive to aircraft NO(x) emissions than to surface emissions. The global warming impact of surface

NO(x) emissions-induced increases in tropospheric ozone is judged to have been overestimated by a factor of 5. O.C.

A92-39044

NOISE FROM TURBINE GENERATORS - NOISE CONTROL, PROPAGATION, AND ASSESSMENT

JORGEN JAKOBSEN (Danish Academy of Technical Sciences, Acoustical Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 303-308. refs

Copyright

The sources and mechanisms of noise from wind turbines are reviewed with attention given to noise-prediction methods and natural and artificial noise masking. Noise control is discussed in terms of the relative contributions of aerodynamic rotor noise and machinery noise, and noise evaluation techniques are described with references to masking considerations. The general conditions for the audibility of turbine noise are given, and an 'acceptability threshold' is defined that is about 4 dB above the audibility threshold in each critical band. C.C.S.

A92-39046

MECHANICAL NOISE FROM LARGE WIND TURBINES - EXPERIENCES FROM SWEDISH PROTOTYPES

STEN LJUNGGREN and MELKER JOHANSSON (DNV Ingemansson, AB, Stockholm, Sweden) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 313-316. refs

Copyright

Noise due to mechanical causes at two wind turbines is studied with attention given to the pure tones generated by turbine machinery and low-frequency noises caused by wake interactions. It is proposed that audible noise from the turbines should not contain pure tones because they are not easily masked by broad-band sounds such as wind noise. The contributions of air- and structure-borne sounds demonstrate the importance of turbine design. C.C.S.

A92-39050

NATO CCMS AIRCRAFT NOISE STUDY ON RECEIVER TECHNOLOGY

A. N. LEFFERTS (Ministry of Defence, The Hague, Netherlands) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 401-406.

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The findings from the NATO Pilot Study on Aircraft Noise are reported as they are relevant to receiver technology with specific details given regarding the effects of noise on humans, noise abatement, and land use. Specific note is made of the lack of clear evidence regarding hearing loss and extraauditory effects in humans that are exposed to sonic booms and other aircraft noise. Noise abatement techniques such as noise barriers are described for ground operations, and moderate noise reduction can be achieved with hush houses during engine testing. Land-use planning is a critical step is noise control, and further research is proposed in such areas as vibration emissions, noise modeling, and the physiological effects of noise. C.C.S.

A92-39052

NOISE FROM MILITARY AIRFIELDS IN THE UNITED KINGDOM

RALPH J. WESTON (RAF, Institute of Community and Occupational Medicine, Halton, England) and BERNARD F. BERRY (National Physical Laboratory, Teddington, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1.

Poughkeepsie, NY, Noise Control Foundation, 1990, p. 413-416. refs

Copyright

The impact of aircraft noise on areas adjacent to military airfields is examined with particular references given to computational models for general aircraft and helicopter noise. The Airnoise modeling technique can map noise-exposure contours resulting from various operations including circuits, and the need for a precise helicopter-noise model is identified. Further development of the Airnoise model with respect to low-level flight and variability in airtracks is proposed in conjunction with a study on noise-health relationships to study the long-term effects of aircraft activity on humans. C.C.S.

A92-39053

AIRPORT NOISE CONTOURS - CONVERTING FROM NNI TO LEQ

J. B. OLLERHEAD (Civil Aviation Authority, Directorate of Operational Research and Analysis, London, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 417-420. refs

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The Noise and Number Index (NNI) for computing noise contours and the Leq contour-calculation technique are described and compared in terms of the accuracy of long-distance calculations. The Leq model was adopted because it can utilize the same program structure and database as the NNI, and the calibration of the sound-exposure-level (SEL) algorithms is described for implementation of the Leq model. The limitations of the Leq model are described with references to possible SEL computations, cutoffs for event SELs, the effects of atmospheric attenuation, and the impact of aircraft turns and power changes. C.C.S.

A92-39054

AIRCRAFT NOISE - THE CALCULATION OF THE NOISE EXPOSURE BY AIRCRAFT IN THE NETHERLANDS

A. N. LEFFERTS (Ministry of Defence, The Hague, Netherlands) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 421-424.

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This paper examines the use of the Kostenunit (Ke) that is based on the maximum A-weighted noise level for calculating the noise-exposure contours at large airports and military airfields. An expression is presented that provides an acceptable correlation between noise exposure and the noise-hindrance rate based on the Ke noise load. Noise-exposure calculations are based on flight, takeoff, and aircraft-type data, and specific attention is given to the factors related to lateral noise distribution. The present calculation methodology is shown to be particularly useful for the assessment of alternative airfield utilization. C.C.S.

A92-39055

DANSIM - DANISH AIRPORT NOISE SIMULATION MODEL - BASIC PRINCIPLES, EXPERIENCE, AND IMPROVEMENTS

BIRGER PLOVSING and CHRISTIAN SVANE (Danish Acoustical Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 425-428. refs

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A review is presented of the objectives, principles, and methodology upon which the Danish Airport Noise Simulation Model (DANSIM) is based. The noise calculation comprises: (1) aircraft calculations to derive sound-exposure levels (SELs); (2) airport-grid determination and manipulation; and (3) contour calculations and plotting. The DANSIM version IV includes the input of dwelling density in the airport region, and all versions are based on the

computation of SEL as functions of distance and aircraft thrust with lateral dispersion. C.C.S.

A92-39057

DANSIM APPLICATIONS - DEVELOPMENT OF AIRPORT NOISE REDUCTION STRATEGIES AND ENVIRONMENTAL POLICY

CHRISTIAN SVANE and BIRGER PLOVSING (Danish Acoustical Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 433-438.

Copyright

The use of the Danish Airport Noise Simulation Model (DANSIM) is proposed for four applications with references to land-use planning and environmental issues. The modeling technique is applied to sensitivity studies, runway-use strategy development, the evaluation of noise from staggered runway approaches, and the assessment of aircraft noise at military shooting ranges. Dansim can calculate noise-exposure criteria from several noise scales and indices for complex traffic situations enabling an understanding of runway-traffic scenarios with subtle differences. C.C.S.

A92-39058

COMPUTATION OF AIRCRAFT NOISE EXPOSURE USING DIGITIZED TOPOGRAPHY DATA

IDAR L. N. GRANOIEN, GEROLD OLSEN, and KARE H. LIASJO (Foundation for Scientific and Industrial Research, Trondheim, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 439-442. refs

Copyright

The use of digitized topographical maps as input data for aircraft-noise-exposure calculations is examined in terms of potential accuracy and feasibility. Attention is focused on a system for computing sound propagation and lateral attenuation called SAE AIR 1751 and the ramifications of introducing the topographical data. The critical corrections to the data include those corresponding to slant range, elevation angle, noise barriers, and hard surfaces. Slant range is treated by calculating the z coordinate, and a routine involving several observation points and terrain smoothing is described for determining the elevation angle. The computer program described could employ digitized topographical data as part of the input data if the method of calculating lateral attenuation is employed. C.C.S.

A92-39064

DETERMINATION OF AIRCRAFT NOISE LEVELS WHILE THE ENGINE IS RUNNING ON THE GROUND - AN APPROACH FROM THE POINT OF URBANIZATION AND ARCHITECTURE

S. YILMAZ (Istanbul Technical University, Turkey) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 463-466. refs

Copyright

Urban planning issues related to aircraft noise propagation are investigated for the case of an aircraft on the ground with its engine running at a range of one mile. Attention is given to the influence of environmental factors such as temperature, atmospheric absorption, and upwind/downwind conditions, and the expressions for determining aircraft noise levels at different receiver points are given. The present treatment of aircraft noise levels related to aircraft running on the ground is shown to be of use in urban planning and architectural design for areas near airports. C.C.S.

A92-39065

DO WE REALLY NEED 57 WAYS OF RATING AIRCRAFT NOISE?

M. J. T. SMITH (Rolls-Royce, PLC, Derby, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control

45 ENVIRONMENT POLLUTION

Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 467-470. Previously announced in STAR as N91-10704. refs
Copyright

The difficulties encountered for measuring and quantifying the effects of aircraft noise are analyzed. The impact of the noise measurement results on the air transport business community is discussed. The common element between all noise measurements and control methodologies are given. The relationship between absolute level and footprint area of constant noise level is presented. The noise certification standards are determined.

Author

A92-42093

ANALYSIS OF WIND TUNNEL DISPERSION DATA OVER TWO-DIMENSIONAL OBSTACLES

F. TROMBETTI and F. TAMPIERI (CNR, Istituto di Fisica della Bassa Atmosfera, Bologna, Italy) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 59, no. 3, May 1992, p. 209-226. Research supported by CNR. refs
Copyright

An analysis of wind tunnel data of dispersion from elevated point sources over a flat floor and gently sloping, 2D hills is performed. Formulas for the mixing lengths and the Lagrangian time scales are tested, suitable for use in various dispersion models. Some expressions for the vertical first moments of the plume concentration distribution suitable for shear flow are also tested. Then, a normalization is suggested, based on the source mean flow and turbulence parameters, for the ground-level concentration maximum value and position along the plume centerline. The maximum values allow the determination of normalized terrain amplification factors.

Author

N92-13494# Office of Technology Assessment, Washington, DC.

BIOTECHNOLOGY IN A GLOBAL ECONOMY. VOLUME 2, PART 1: CONTRACTOR DOCUMENTS

Jun. 1991 259 p

(PB91-212068) Avail: CASI HC A12/MF A03

Volume 2, part 1 of this report is comprised of various papers relating to the biotechnology industry and its level of development in various countries. Major topics discussed include the current status of the industry in these countries, financing sources, future strategies, special projects being pursued, and technology transfer.

GRA

N92-20574# Rolls-Royce Ltd., Derby (England).

THE ENVIRONMENTAL IMPACT OF COMMERCIAL AVIATION: THE EVOLUTION OF EXHAUST EMISSIONS LEGISLATION AND CONTROL TECHNOLOGY

G. PILKINGTON and A. B. WASSELL 14 Apr. 1991 8 p (PNR-90847; ETN-92-90797) Copyright Avail: CASI HC A02/MF A01

Interest in the environmental impact of turbine powered aircraft was kindled in the early 1960s by the black smoke trails emanating from engines that also emitted the characteristic high noise levels of high velocity exhaust jets. The introduction of more powerful engines, jet mixing, and combustors with leaner primary zones occurred in parallel with the development of the first environmental legislation towards the end of the decade. The 1970s were characterized by the introduction of the high ratio engines with low noise levels and invisible exhausts. Attention was then turned to the invisible exhaust emissions and initial estimates were made of their effect on the environment. This activity resulted in international guidelines for both noise and emissions by 1981. All commercial aircraft engines currently being produced now meet these standards and discussions have started to see whether these standards are still appropriate for the start of the next century or whether more stringent standards should be considered.

ESA

N92-20928# Rolls-Royce Ltd., Derby (England).

THE ENVIRONMENTAL CHALLENGES FOR THE NEXT SUPERSONIC AIRCRAFT

M. J. T. SMITH 9 Nov. 1990 6 p Presented at the Japan Society for Aeronautical and Space Sciences 28th Aircraft Symposium, Tokyo, Japan, 7-9 Nov. 1990 (PNR-90782; ETN-92-90768) Copyright Avail: CASI HC A02/MF A01

Most people would accept that there will, one day, be a Second-generation Supersonic Transport (SST). At the same time, in an era of heightening environmental awareness, one can assume that there will be progressively more stringent restrictions on both exhaust emissions and noise. Indeed, because aircraft deliver all their pollutants directly to the upper atmosphere, they may come under a far more powerful microscope than land based consumers of fossil fuels. At the same time, noise, although a pollutant with far less effect in human well being, will always be a political stalking horse and, in the case of the SST, there is the added issue of the sonic boom. Hence, the next SST will be faced with more and bigger environmental hurdles than aroused the 'green' interest in the Concorde 20 years ago. Designers will have to anticipate the stringency of environmental legislation to ensure that their new SST can fly alongside subsonic contemporaries without any operational and, therefore, commercial disadvantages. The environmental regulatory situation and ways in which targets may be met are discussed. Special attention is given to exhaust emission and noise restrictions.

ESA

N92-21743# Rolls-Royce Ltd., Derby (England).

ENVIRONMENTALLY SOUND

M. J. T. SMITH and K. GODDARD 1 Oct. 1990 14 p Presented at the 3rd Annual Conference in Techno-Economic Issues, London, England, 31 Aug. 1990

(PNR-90776; ETN-92-90764) Copyright Avail: CASI HC A03/MF A01

Developments made in stage 2 aircraft since 1989 are reviewed. In brief, the events are as follows: the first stage 2 aircraft to be reengined with a stage 3 Rolls-Royce Tay has flown; the first order for stage 3 Tay engines to replace stage 2 Pratt and Whitney JT8Ds in the Boeing 727 has been secured; Europe has decided on its future policy in the phase out of the stage 2 fleet; airports around the world have progressively tightened their stranglehold in stage 2 operations; it has become clear that simple hushkits are only marginal stop gap methods of hiding from tomorrow's environmental problems; concern about atmospheric pollution has cast another shadow over the old engines now powering the stage 2 fleet; Rolls-Royce is re-examined the development of a large Tay engine directed at the re-engining market.

ESA

N92-25238# Aerospatiale, Les Mureaux (France).

EUROPEAN INDUSTRIAL CAPABILITIES TO PROVIDE METEOROLOGICAL SPACE SYSTEMS

MICHEL DELAYE In ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space p 83-87 Oct. 1991 Copyright Avail: CASI HC A01/MF A02

Avoidance of technological gambles and determination to arrive simple specific actions are identified as being key aspects of Meteosat's success. As the first European operational space program, Meteosat has proven how a well conceived system, developed and maintained in a close knit collaboration between space agencies and European industries, can stay alive from the early seventies to the year 2000. European industrial companies extend their action in the framework of the ESA-Eumetsat collaboration on second generation Meteosat as well as in the framework of the Eumetsat-NOAA potential collaboration for meteorological polar satellites. European industrial capabilities in design and development of spaceborne sensors for advanced meteorological and environmental instruments, are described. Meteosat speaks for the ability of European industry to contribute to the development and operation of a spaceborne operational system for the observation and study of the Earth's environment.

ESA

N92-25242# Dornier System G.m.b.H., Friedrichshafen (Germany).

THE ENGAGEMENT OF GERMAN SPACE INDUSTRY IN NATIONAL AND EUROPEAN ENVIRONMENTAL SPACE PROGRAMMES Abstract Only

ECKART LANGEUEDDECKE *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space p 107 Oct. 1991

Copyright Avail: CASI HC A01/MF A02

The broad awareness of environmental problems has clearly grown during the last decade in connection with the knowledge that solutions will rarely be available on a national basis but will require large scale or even global considerations. It has also become obvious in the past that effective countermeasures tend to have severe economical impacts. Comprehensive and accurate information in environmental phenomena, processes, and interactions are needed to move the responsible authorities into action. Some of those requirements and the contributions which can be provided by Earth observation satellites are summarized. Typical Earth observation missions with major involvement of the German space industry, like ERS-1, Atmos, and POEM-1, are described together with their mission objectives and relations to environmental questions. An overview is given of active and passive sensors and instruments, operating in different spectral areas and frequency bands. Examples of German space industry's activities in the fields of ground segment development and data processing and utilization are presented. ESA

N92-25243# Consejo Superior de Investigaciones Cientificas, La Laguna (Spain). Inst. de Astrofisica de Canarias.

PLANETARY VISION AS A STRATEGY

FRANCISCO SANCHEZ *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space p 113-115 Oct. 1991

Copyright Avail: CASI HC A01/MF A02

From space the Earth can be seen from the outside. This must be taken into consideration when making models with planetary vision of the layer which we call the Earth's environment. The fundamental problems are global; therefore tackling them, and getting to the root of the matter, requires not an analytical but rather a synthetic approach, with planetary vision. The history of human progress can be understood as a cultural and financial conquest by a series of scales; we are only now entering into the planetary scale. This is another reason why the role which Space can play is decisive. It can provide mankind with a radically different way of contemplating his habitat. It can show him his home from the outside. This makes it even more obvious that we all depend on everyone and everything. Research programs carried out throughout Spain in the areas of teledetection and multidisciplinary modeling of topics related to environmental research are described. ESA

N92-25245# State Secretary of Science Policy, Brussels (Belgium).

THE ROLE OF BELGIUM IN EARTH OBSERVATION FROM SPACE PROGRAMS [LA BELGIQUE ET LES PROGRAMMES D'OBSERVATION DE LA TERRE A PARTIR DE L'ESPACE]

ERIC DERYCKE *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space p 121-123 Oct. 1991 *In* FRENCH

Copyright Avail: CASI HC A01/MF A02

The role played by Belgium in Earth observation from space programs is outlined. The role of Belgium in the SPOT program, the Mir Infra Red Atmosphere Spectrometer (MIRAS), the space teledetection program and the global change program is described. The need for including considerations of life quality, starting with a concern for the environment in the politics of scientific research is stressed. The consequences of such an approach to scientific research in general and space research in particular are considered. ESA

N92-26473 Oxford Univ. (England).

TRACER TRANSPORT IN THE MIDDLE ATMOSPHERE Ph.D.

Thesis

NEIL F. ARNOLD 1990 231 p

Avail: Univ. Microfilms Order No. BRD-94131

The discovery of the ozone hole over Antarctica has stimulated a great deal of interest in the interaction between dynamics, radiation, and chemistry in the middle atmosphere. A hierarchy of tracer transport models was adopted to help to understand the results of satellite observations and detailed computer simulations. Zonally averaged models have met with some success in simulating the atmosphere because it is close to radiative/chemical equilibrium in the summer. A zonally averaged circulation derived from satellite observations of temperature and ozone was used to test various advection schemes and to reproduce the zonal mean seasonal cycle of long-lived tropospheric source gases. Three dimensional models impose more severe demands and so a number of finite difference schemes were reviewed and tested under idealized atmospheric conditions. To reduce the computational effort, winds were generated by the Meteorological Office Stratosphere Mesosphere Model (SMM) and passed to a transport model. The best transport scheme was the one which most closely resembled that used for heat and momentum transport. Time averaging of the winds was necessary to produce representative fields in the mesosphere. When the transport scheme was incorporated into the SMM, agreement between the dynamically derived potential temperature and potential vorticity and the tracer equivalents were very good. During a major warming, the discrepancy between the vortex maximum between the model potential vorticity and the equivalent material tracer fields was 12 percent in the middle stratosphere and 50 percent in the upper stratosphere after twenty days. Most of this difference was due to the sensitivity of the potential vorticity to diabatic heating. Extensions of the work to include chemistry and more sophisticated satellite-derived circulations were suggested. Dissert. Abstr.

N92-29304*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LIDAR MEASUREMENTS OF AEROSOL AND OZONE DISTRIBUTIONS DURING THE 1992 AIRBORNE ARCTIC STRATOSPHERIC EXPEDITION

E. V. BROWELL, C. F. BUTLER (ST Systems Corp., Hampton, VA.), M. A. FENN, W. B. GRANT, and A. F. CARTER *In* its Sixteenth International Laser Radar Conference, Part 1 p 285-288 Jul. 1992

Avail: CASI HC A01/MF A04

The LaRC airborne lidar system was operated from the ARC DC-8 aircraft during the 1992 Airborne Arctic Stratospheric Expedition (AASE-2) to investigate the distribution of stratospheric aerosols and O₃ across the Arctic vortex from Jan. to Mar. 1992. Monthly flights were made across the Arctic vortex from Anchorage, Alaska, to Stavanger, Norway, and then back to Bangor, Maine, and additional round-trip flights north into the vortex were made each month from either Stavanger or Bangor depending on the location of the vortex that month. The airborne lidar system uses the differential absorption lidar (DIAL) technique at laser wavelengths of 301.5 and 310.8 nm to measure O₃ profiles above the DC-8 over the 12-25 km altitude range. Lidar measurements of aerosol backscatter and depolarization profiles over the 12-30 km altitude range are made simultaneously with the O₃ measurements using infrared (IR) and visible (VIS) laser wavelengths of 603 and 1064 nm, respectively. The measurements of Pinatubo aerosols, polar stratospheric clouds, and O₃ made with the airborne DIAL system during the AASE-2 expedition and to chemical and dynamical process that contribute to O₃ depletion in the wintertime Arctic stratosphere. Author

N92-29306*# Paris VI Univ. (France). Service d'Aeronomie.

AEROSOLS AND POLAR STRATOSPHERIC CLOUDS MEASUREMENTS DURING THE EASOE CAMPAIGN Abstract Only

D. HANER, S. GODIN, G. MEGIE, C. DAVID, and V. MITEV *In*

NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 291 Jul. 1992
 Avail: CASI HC A01/MF A04

Preliminary results of observations performed using two different lidar systems during the EASOE (European Arctic Stratospheric Ozone Experiment), which has taken place in the winter of 1991-1992 in the northern hemisphere latitude regions, are presented. The first system is a ground based multiwavelength lidar intended to perform measurements of the ozone vertical distribution in the 5 km to 40 km altitude range. It was located in Sodankyla (67 degrees N, 27 degrees E) as part of the ELSA experiment. The objectives of the ELSA cooperative project is to study the relation between polar stratospheric cloud events and ozone depletion with high vertical resolution and temporal continuity, and the evolution of the ozone distribution in relation to the position of the polar vortex. The second system is an airborne backscatter lidar (Leandre) which allows for the study of the 3-D structure and the optical properties of polar stratospheric clouds. The Leandre instrument is a dual-polarization lidar system, emitting at 532 nm, which allows for the determination of the type of clouds observed, according to the usual classification of polar stratospheric clouds. More than 60 hours of flight were performed in Dec. 1991, and Jan. and Feb. 1992 in Kiruna, Sweden. The operation of the Leandre instrument has led to the observation of the short scale variability of the Pinatubo volcanic cloud in the high latitude regions and to several episodes of polar stratospheric clouds. Preliminary analysis of the data is presented. Author

N92-29499# Beleidscommissie Remote Sensing, Delft (Netherlands).

THE MAIN LINES OF THE RESEARCH PROGRAMS REMOTE SENSING: CLIMATE AND ENVIRONMENT [PROGRAMMA OP HOOFDLIJNEN 'REMOTE SENSING - KLIMAAT EN MILIEU']

P. J. H. BUILTJES (Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft, Netherlands) and M. G. M. ROEMER (Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft, Netherlands) Sep. 1991 13 p In DUTCH

(Contract BCRS PROJ. 6.5/IS-11)

(BCRS-91-25; ISBN-90-54-11001-5; ETN-92-91610) Avail: CASI HC A03/MF A01

The main lines of a remote sensing research program were established with a view to the selection of research projects in the field of atmospheric chemistry and physics in relation to climate and environment. The research program concerns remote sensing from ground level, from balloons, and from aircraft. The relation between the current and planned research program is outlined. General considerations concerning the short term aims of the research program as well as the long term infrastructure are given. ESA

N92-33751# Rolls-Royce Ltd., Derby (England).

THE IMPACT OF AIR TRANSPORT ON THE ENVIRONMENT

M. T. METCALFE, R. A. EATON, and D. M. SNAPE 1 Oct. 1991 9 p

(PNR-90876; ETN-92-92186) Copyright Avail: CASI HC A02/MF A01

The impact of atmospheric emissions upon the environment and the understanding of the contribution made by aircraft engines to pollution globally, in the vicinity of airports and at high altitudes, are considered. The technical status and future improvements in combustor technology, now under development, are addressed generally. The often conflicting requirements of emissions reduction and the other established combustor performance factors are examined. Particular stress is placed on safety aspects. The concept of an Environmental Impact Parameter (EIP), which would allow the optimization of engine cycle, and combustor design, to minimize the environmental consequences throughout the flight cycle, is introduced. The EIP could take into account the relative environmental importance of each emission species. ESA

GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

A92-10629

LONG-LIVED POLAR THERMOSPHERIC VORTICES - A COMBINED RADAR AND OPTICAL STUDY

D. REES, S. BATTEN, A. L. ARULIAH, T. J. FULLER-ROWELL (University College, London, England), A. D. FARMER, and K. S. C. FREEMAN (Rutherford Appleton Laboratory, Didcot, England) (Thermospheric and ionospheric dynamics; Symposium, Exeter, England, July 1989, Selected Papers. A92-10626 01-46) Journal of Atmospheric and Terrestrial Physics (ISSN 0021-9169), vol. 53, June-July 1991, p. 493-514. Research supported by SERC. refs Copyright

A Doppler Imaging System has been used to map the polar thermospheric circulation in the vicinity of the high-latitude station of Kiruna (67 deg N, 20 deg E), in conjunction with extended coverage of ionospheric plasma flow patterns obtained simultaneously by the EISCAT radar facility. Combined wind and radar results were obtained during the nights of 24/25 and 25/26 November 1987. On 24 November 1987, a strong anticyclonic vortex was generated within the region of the dusk auroral oval and polar cap, associated with sunward wind velocities in the dusk auroral oval, of up to 400 m/sec. These winds were generated by the combination of ion drag and the resonant response of the thermosphere. The observations of this sustained anticyclonic vortex on the night of 24/25 November confirmed a concept predicted earlier by theoretical modeling. Following the intense activity which led to their generation, such vortices may survive during several hours of decreasing geomagnetic activity. The decrease of viscosity with decreasing altitude and the decrease of plasma density in the ionosphere below-250 km limits the viscous and the electrodynamic dissipation of the thermospheric 'flywheel'. Author

A92-24532

SIGNATURES OF TRANSIENT BOUNDARY LAYER PROCESSES OBSERVED WITH VIKING

J. WOCH and R. LUNDIN (Swedish Institute of Space Physics, Kiruna, Sweden) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, Feb. 1, 1992, p. 1431-1447. Research supported by Swedish Board of Space Activities. refs Copyright

Observations of magnetosheath plasma intrusion made by Viking in the dayside magnetosphere at auroral latitudes are presented. The intrusion is not connected with the well-known quasi-steady state entry of magnetosheath plasma in the cusp regions; rather, it is of a temporal, transient type. Since these intrusion events are observed on flux tubes which are populated by background boundary layer plasma and which were shown to map close to the magnetospheric boundary, it is concluded that they are the midlatitude signatures of transient solar wind/magnetosphere interaction processes. The event distribution in MLT peaks well away from noon in the postdawn and predusk sectors. Although the occurrence probability in the dawn and dusk sectors is nearly equal, the dawnside events are generally more pronounced. It is inferred that the magnetosheath plasma intrusion events are related to ground-based observations of magnetic impulsive events or so-called traveling ionospheric vortices. P.D.

A92-30638

THE UPPER ATMOSPHERE AS SENSED BY SATELLITE ORBITS

D. G. KING-HELE Planetary and Space Science (ISSN 0032-0633), vol. 40, Feb.-Mar. 1992, p. 223-233. refs Copyright

This paper offers a personal (and therefore biased) survey of

the advances in knowledge of the thermosphere made possible by measuring the changes in the orbits of satellites, particularly in the early years of the space era. Reliable numerical values of air density at heights above 200 km were obtained for the first time, and many different types of variation in density were discovered and codified. Subsequently the orbital changes were analyzed to determine other atmospheric parameters, such as scale height and zonal winds. Author

A92-31271

MEASUREMENT OF FIELD-ALIGNED CURRENTS BY THE SABRE COHERENT SCATTER RADAR

M. P. FREEMAN, D. J. SOUTHWOOD (Imperial College of Science, Technology, and Medicine, London, England), M. LESTER (Leicester, University, England), and J. A. WALDOCK (Sheffield City Polytechnic, England) IN: Physics of magnetic flux ropes. Washington, DC, American Geophysical Union, 1990, p. 575-580. refs

Copyright

The calibration of methods used in the Sweden and British Auroral Radar Experiment for the measurement of magnetospheric field-aligned currents, using coherent scatter radar data, is discussed. The technique is applied to identify and analyze a localized upward field-aligned current sheet observed in the late afternoon midlatitude ionosphere. This current arises from the earthward transport of hot plasma, due to ongoing magnetospheric erosion. Author

A92-31275* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TERRESTRIAL IONOSPHERIC SIGNATURES OF FIELD-ALIGNED CURRENTS

E. FRIIS-CHRISTENSEN (Danish Meteorological Institute, Copenhagen, Denmark) IN: Physics of magnetic flux ropes. Washington, DC, American Geophysical Union, 1990, p. 605-610. refs

(Contract NAG5-584)

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The occurrence of traveling field-aligned current filaments and twin-vortex patterns is suggested to be related to sudden changes in solar wind dynamic pressure and/or the IMF. Greenland magnetometer observations of the cleft region magnetic perturbations associated with small-scale twin-vortex patterns show that these events occur on both sides of the magnetic local noon, contradicting Glassmeier et al.'s (1989) statistical analysis of 82 twin-vortex subauroral-latitude events obtained by the Scandinavian Magnetometer Array; the stations are closer to the ionospheric projection of the cleft earlier in magnetic local time, relative to the across-the-cleft-located Greenland stations. O.C.

A92-37905

ON INERTIAL WAVES IN THE EARTH'S FLUID CORE

KEKE ZHANG (Exeter, University, England) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 8, April 24, 1992, p. 737-740. Research supported by Leverhulme Trust. refs

(Contract NERC-GR/3/8238)

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Solutions of the Poincare equation in a full sphere are examined, and it is shown that the inertial oscillation with the simplest spatial latitudinal structure is trapped in the equatorial boundary region. The effects of an inner sphere are shown to be negligibly small. It is further found that equatorially symmetric inertial waves belong to a particular subclass of thermal instabilities. The selection of a physically realizable inertial mode can thus be understood within the framework of instability theory. A perturbation theory of thermal convection is established on the basis of the Poincare equation. V.L.

A92-41800

CHARGED DUST IN THE EARTH'S MESOPAUSE - EFFECTS ON RADAR BACKSCATTER

O. HAVNES, FRANK MELANDSO, CESAR LA HOZ, T. K. ASLAKSEN (Auroral Observatory, Tromso, Norway), and T.

HARTQUIST (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Federal Republic of Germany) Physica Scripta (ISSN 0031-8949), vol. 45, no. 5, May 1992, p. 535-544. refs

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The paper discusses to what extent small scale density inhomogeneities in the dust distribution may influence radar backscatter in the summer mesopause. It is shown, for a reasonable range of parameters, that falling dust interacting with a neutral gas vortex cannot penetrate to the center of the vortex. The size of the hole in the dust space density distribution around the vortex center depends on the vortex size and rotation speed and on the free fall velocity of the dust. If the dust contains a nonnegligible fraction of the space charge (this requires that the dust is charged by the photoelectric effect), a substantial gradient in the positive charge density across the dust hole edge results. The positive charge density profile in the thin boundary layer will depend on the size distribution of the dust grains. A corresponding gradient in the electron density will appear, and the conditions under which it will lead to a radar reflection of the magnitude observed in the summer polar mesosphere are discussed. Author

A92-52876

AIRBORNE FAR-INFRARED HETERODYNE REMOTE SENSING OF STRATOSPHERIC OH - A FEASIBILITY STUDY

S. MILLER, M. BIRK, F. SCHREIER, and D. HAUSAMANN (DLR, Institut fuer Optoelektronik, Oberpfaffenhofen, Germany) International Journal of Infrared and Millimeter Waves (ISSN 0195-9271), vol. 13, no. 9, Sept. 1992, p. 1241-1268. refs

Copyright

It is shown that an airborne FIR heterodyne receiver is capable of meeting the need for a versatile stratospheric OH sensor. This sensor will provide a technique for vertical sounding of OH for the first time. A review is presented concerning OH chemistry of the stratosphere and the currently available means of stratospheric OH measurements from balloon-borne platforms. The need is thereby shown for extensive measurements of OH and its related molecules in order to help remove discrepancies between previous OH measurements and to understand differences between measurements and models. The expected SNR for OH, HOCl, HO₂, ClO, H₂O, and O₃ is determined using the FASCOD2 radiative transfer code. An extended version of the code is used to show that retrieval of OH concentration profiles from the spectral line shape is clearly possible, and the expected accuracy and altitude resolution will be adequate. This instrument can perform limb sounding aboard a stratospheric research aircraft at an altitude of 24 km. S.A.V.

A92-54645* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

OPTICAL EFFECTS OF POLAR STRATOSPHERIC CLOUDS ON THE RETRIEVAL OF TOMS TOTAL OZONE

O. TORRES, Z. AHMAD (Hughes STX Corp., Lanham, MD), and J. R. HERMAN (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. D12, Aug. 20, 1992, p. 13,015-13,024. refs

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Small areas of sharply reduced ozone density appear frequently in the maps produced from polar region total ozone mapping spectrometer (TOMS) data. These mini-holes are of the order of 1000 km in extent with a lifetime of a few days. On the basis of measurements from ground-based instruments, balloon-borne ozonesondes, and simultaneous measurements of aerosol and ozone concentrations during aircraft flights in the Arctic and Antarctic regions, the appearance of polar stratospheric clouds (PSCs) are frequently associated with false reductions in ozone derived from the TOMS albedo data. By combining radiative transfer calculations with the observed PSC and ozone data, it is shown that PSCs located near or above the ozone density maximum (with optical thickness greater than 0.1) can explain most of the differences between TOMS ozone data and ground or in situ ozone measurements. Several examples of real and false TOMS mini-hole phenomenon are investigated using data from the 1989 Airborne

Arctic Stratospheric Expedition (AASE) and from balloon flights over Norway and Sweden. Author

A92-55089

**TRAVELING MAGNETOSPHERIC CONVECTION
TWIN-VORTICES - OBSERVATIONS AND THEORY**

KARL-HEINZ GLASSMEIER (Braunschweig, Technische Universitaet, Germany) Annales Geophysicae (ISSN 0992-7689), vol. 10, no. 8, Aug. 1992, p. 547-565. refs

Copyright

Key observations concerning traveling magnetospheric convection twin-vortices (TMCTWs) are reviewed in detail with particular attention given to mechanisms for generating such twin-vortex systems, namely, magnetic reconnection and change of the magnetopause pressure balance. Twin-vortex structures are found to be associated with a pair of upward and downward flowing field-aligned current with densities up to $10 \exp -9$ A/sq m. Observations of dayside auroral activity support the hypothesis that large currents may eventually become unstable, and potentially lead to particle acceleration. It is concluded that isolated transient magnetic effects and associated with them TMCTWs are in many respects the dayside analog of the nightside substorm events.

O.G.

A92-55441

**GASEOUS SULFURIC ACID AND SULFUR DIOXIDE
MEASUREMENTS IN THE ARCTIC TROPOSPHERE AND
LOWER STRATOSPHERE - IMPLICATIONS FOR HYDROXYL
RADICAL ABUNDANCES**

O. MOEHLER and F. ARNOLD (Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 17, Sept. 4, 1992, p. 1763-1766. Research supported by BMFT. refs

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Measurements of gaseous sulfuric acid and sulfur dioxide were made in the winter Arctic troposphere and lower stratosphere using aircraft-borne mass spectrometers. The measurements, covering altitudes between 3.5 and 11.4 km, took place on 14 and 18 February, 1987 in northern Scandinavia. The abundance of H₂SO₄ was around 0.01 to 0.06 pptv (parts per trillion by volume), and the measured SO₂ volume mixing ratios are around 50 to 400 pptv in the troposphere and decrease steeply above the tropopause to about 10 pptv. This decrease above the tropopause is in contrast to previous measurements showing constant or even increasing SO₂ mixing ratios. The combined H₂SO₄ and SO₂ measurements offer an interesting opportunity to infer hydroxyl radical concentrations. Inferred OH concentrations are around $0.1-1.0 \times 10 \exp 5/\text{cu cm}$ being roughly consistent with model predictions for winter time high latitudes. Author

N92-13512# Naval Postgraduate School, Monterey, CA.

**AIRCRAFT OBSERVATIONS OF THE ATMOSPHERIC
BOUNDARY LAYER IN THE VICINITY OF THE MARGINAL ICE
ZONE UNDER CONDITIONS OF FLOW PARALLEL TO THE
ICE EDGE M.S. Thesis**

TERESA M. GOBEL Sep. 1990 55 p
(AD-A241072) Avail: CASI HC A04/MF A01

This paper describes aircraft observations made with the NOAA P-3 research aircraft on 24 March 1989. The measurement region was over the marginal ice zone, southeast of Spitzbergen, between 74 to 76 degs N and 19 to 27 degs E. Above the atmospheric boundary layer, the geostrophic wind was 12 m/s at approximately 15 deg off-ice. A well mixed layer extended along the entire 200 km flight path which was perpendicular to and centered over the ice edge. There was a stratocumulus layer over the ocean which decreased in thickness towards the ice. The associated inversion, which coincided with the cloud layer top, continued to decrease in height over the ice. This caused a strong thermal wind effect within the atmospheric boundary layer. The near-surface geostrophic wind decreased from approximately 12 m/s over the ocean to 5 m/s over the ice due to the horizontal temperature gradient and sloping inversion. GRA

N92-14498 Edinburgh Univ. (Scotland).

**THE STRATOSPHERIC RESIDUAL CIRCULATION AS
DEDUCED FROM SATELLITE DATA Ph.D. Thesis**

STEPHEN REUBEN BEAGLEY 1989 292 p

Avail: Univ. Microfilms Order No. BRD-92844

In 2-D modeling of the stratosphere, the residual circulation and the TEM equation re-formulation are put forward as a satisfactory analysis framework. Satellite data, principally from the LIMS and SSU instruments, is used to examine the residual circulation for the period Dec. 1978 to Nov. 1979. What drives the circulation and how the various components and forcing mechanisms vary through the seasons and between the hemispheres are investigated. In particular, the role of the eddy forcing, both time averaged and transient, in driving the residual circulation and in the momentum and heat budgets is examined. The residual circulation is examined in various forms. The eddy driven circulations were seen to be important components of the total residual circulations evaluated and provided necessary contributions in the budgets of momentum and heat. The magnitude of the principal eddy forcing term, $D(\text{sub } f)$, is shown to be large during several months and so must result in vigorous mixing which for a complete description of the total transport must be parameterized when use of a residual circulation is made in modeling. A number of important variations in seasonal behavior and differences between hemispheres were observed which could have important consequences upon the transport of tracer quantities. Dissert. Abstr.

N92-14541*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**HOMOGENEOUS AND HETEROGENEOUS CHEMISTRY
ALONG AIR PARCEL TRAJECTORIES**

R. L. JONES (Meteorological Office, Bracknell (England).), D. L. MCKENNA (Meteorological Office, Bracknell (England).), L. R. POOLE, and S. SOLOMON (National Oceanic and Atmospheric Administration, Boulder, CO.) In NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 p 239-240 Jan. 1990

Avail: CASI HC A01/MF A03

The study of coupled heterogeneous and homogeneous chemistry due to polar stratospheric clouds (PSC's) using Lagrangian parcel trajectories for interpretation of the Airborne Arctic Stratosphere Experiment (AASE) is discussed. This approach represents an attempt to quantitatively model the physical and chemical perturbation to stratospheric composition due to formation of PSC's using the fullest possible representation of the relevant processes. Further, the meteorological fields from the United Kingdom Meteorological office global model were used to deduce potential vorticity and inferred regions of PSC's as an input to flight planning during AASE. Author

N92-19292# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

**SIMPLE MODELS FOR THE DESCRIPTION OF TURBULENCE
IN THE ATMOSPHERIC BOUNDARY LAYER**

ANNE M. JOCHUM Nov. 1990 82 p In GERMAN; ENGLISH summary
(ISSN 0939-2963)

(DLR-FB-90-17; ETN-92-90731) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 27 DM

Simple methods for classifying atmospheric boundary layer states and describing atmospheric boundary layer turbulence over homogeneous land surfaces are reviewed. A new method is proposed to evaluate turbulence parameters from routine meteorological observations. This method is based on a combination of similarity theory and available parameterization schemes for surface fluxes and atmospheric boundary layer depth. It consists of a basic module of a simple method to predict and evaluate aircraft reaction in turbulent air on a routine basis. ESA

N92-24659# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.

A NOTE ON THE INTERANNUAL VARIABILITY OF THE POLAR VORTEX IN THE ARCTIC

K. LABITZKE /In ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 407-411 Nov. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The intensity of the Arctic polar vortex in winter appears to be affected by the state of the Quasi-Biennial Oscillation (QBO) in the equatorial stratospheric wind. Recent model experiments substantiate this observation. The theoretical association between the QBO and the vortex should be cold and intense; with an easterly QBO it should be weaker and warmer. It has been observed, however, that this relationship fails during maxima in the 11 year solar cycle. The recent stratospheric winters, including that of the DYANA campaign, are discussed in this context.

ESA

N92-26295# Oslo Univ. (Norway). Dept. of Physics.

THE NORWEGIAN UPPER ATMOSPHERE PROGRAMME IN SVALBARD (NORWAY)

J. A. HOLTET (Oslo Univ. (Norway).) and A. BREKKE (Auroral Observatory, Tromsø, Norway) /In ESA, Cluster Dayside Polar Cusp p 5-9 Dec. 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

Observations from Svalbard, the Arctic archipelago between 10 and 35 deg east and 74 and 81 deg north are reported. The geomagnetic latitude spans from approx. 71 and 77 deg north. The high geographic latitude at a geomagnetic latitude of 75 deg, makes Svalbard an ideal place for studies of dayside aurora and processes in the magnetospheric boundary regions. Conjugacy to stations in Antarctica makes Svalbard even more attractive. The observatories at Ny-Alesund and Longyearbyen are the master stations in a network which also includes field stations at Hopen, Hornsund, Bjørnøya and Jan Mayen. The core instruments are photometers, optical imagers, magnetometers and riometers. Instruments such as spectrometers and ULF/ELF/VLF receivers add to the data sets. The observations form the basis for various studies of solar wind/magnetosphere coupling, electrodynamics, transient events and other magnetospheric and boundary layer phenomena. International cooperation is essential in the program.

ESA

N92-26301# British Antarctic Survey, Cambridge (England).

ANTARCTIC STUDIES OF THE CUSP

A. S. RODGER /In ESA, Cluster Dayside Polar Cusp p 35-41 Dec. 1991

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

Results from Antarctic studies are summarized. The advantages of these results from the very large displacement of the geographic and geomagnetic poles, there being a land mass upon which to deploy experiments, and a pollution free environment in which to make observations, are considered. In recent years, important results concerning the coupling of solar wind processes through the magnetosphere and into the ionosphere were determined using Antarctic datasets. The present and planned observing programs that are likely to be in place during the Cluster mission are also described.

ESA

N92-26310# Swedish Inst. of Space Physics, Kiruna.

THE NEED OF COORDINATED OBSERVATIONS IN SPACE AND FROM GROUND

BENGT HULTQVIST /In ESA, Cluster Dayside Polar Cusp p 123-127 Dec. 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

The different role of ground based and spacecraft measurements are reviewed. The importance of the ground based measurements for the satellite projects is discussed. The ground

based global observatory networks provide necessary reference systems for the 'front line' measurements on board satellites. Investigations of dynamic phenomena on a global scale depend primarily on the ground based networks, which provide continuity in space and time, but satellites contribute local observations of great importance for the progress of the research. The need of coordination of many kinds of measurements characterizes the solar terrestrial physics field. The main international coordinated program in the 90s is STEP (Solar Terrestrial Energy Program).

ESA

N92-26315# Academy of Sciences, Graz (Austria). Inst. of Space Research.

BALLOONS FOR CONJUGATE CUSP STUDIES IN THE 1990'S

W. RIEDLER (Austrian Science Research Council, Graz.), IVER B. IVERSEN (SPW, Birkerød, Denmark), and K. M. TORKAR /In ESA, Cluster Dayside Polar Cusp p 171-178 Dec. 1991

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

The advantages of balloonborne measurements for magnetospheric studies is reviewed and a scenario of possible balloon, campaigns during the Cluster mission, with emphasis on the dayside polar cap region, is proposed. The proposal is preceded by a description of earlier and similar campaigns carried out in northern Europe and the Svalbard Islands (Arctic).

ESA

N92-26318# Rutherford High Energy Lab., Chilton (England).

REQUIREMENTS FOR COORDINATED CLUSTER AND GROUND-BASED OBSERVATIONS OF THE CUSP

MIKE LOCKWOOD /In ESA, Cluster Dayside Polar Cusp p 203-207 Dec. 1991

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The spatial and temporal resolutions and the fields of view required of ground based observations of the cusp are discussed by considering a typical example of a dayside auroral transient and plasma flow burst. Systems meeting such specifications would also be ideal for studying traveling convection vortices and would undoubtedly reveal new spatial structure and temporal behavior of the cusp region. The implications of the Cluster orbit characteristics for coordinated cusp observations with ground based instruments are discussed.

ESA

N92-26329# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

CONTRIBUTIONS TO ATMOSPHERIC PHYSICS IN HONOR OF DR. MANFRED REINHARDT ON HIS 65TH BIRTHDAY [BEITRAEGE ZUR PHYSIK DER ATMOSPHAERE, GEWIDMET DR. MANFRED REINHARDT ZUM 65 GEBURTSTAG]

ULRICH SCHUMANN, ed. and KLAUS-PETER HOINKA, ed. Sep. 1991 229 p In ENGLISH and GERMAN Original contains color illustrations

(ISSN 0939-2963)

(DLR-FB-91-30; ETN-92-91389) Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Theoretical, analytical and numerical work on the tropospheric process are discussed. The Eady model is reformulated. Vortex interaction and potential vorticity inversion are examined. Transport paths of air pollutions are investigated. Frontogenetical structures are compared. A simple model is derived for the convective boundary layer. The stability of barotropic vortices is studied. Aircraft observatories of a small scale solitary wave are reported. Climatic observations are presented. The existence of a capital similarity is assessed: ozone trends are given. Measuring systems are described. Results of field experiments are reported.

ESA

N92-26331# Technische Univ., Munich (Germany). Inst. fuer Meteorologie.

UPPER/LOWER VORTEX INTERACTION AND POTENTIAL VORTICITY INVERSION

JOSEPH EGGER /In DLR, Contributions to Atmospheric Physics

in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 11-20 Sep. 1991

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Upper/lower vortex interaction is studied using balance models where all flow variables are derived through an inversion of the potential vorticity distribution. The motion of vortices in shear flow so that an upper level vortex may move over a low level vortex is considered. Such models are found to help in understanding the interaction process. In particular, the inversion procedure predicts the pronounced deepening of the upper level trough if the upper vortex is located above the lower vortex. ESA

N92-26336# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

AIRCRAFT OBSERVATION OF A SMALL-SCALE SOLITARY WAVE NEAR THE TROPOPAUSE

THOMAS HAUF *In its* Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 65-70 Sep. 1991

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Aircraft observations at 10,100 m height provide evidence for a small scale solitary wave with 130 m half amplitude width. The instant snapshot taken with the aircraft is consistent with what is known from solitary waves. The measurements are discussed and the structures of the solitary wave are analyzed. ESA

N92-26340# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

CIRRUS CLOUDS AND CONDENSATION TRAIL ON 18 OCT. 1989 OVER THE NORTH SEA (ICE '89). DETERMINATION OF HEIGHT AND OPTICAL DEPTH USING ALEX, AVHRR AND HIRS [CIRREN UND KONDENSSTREIFEN AM 18-10-89 UEBER DER NORDSEE (ICE '89): EMITTLUNG VON HOEHE UND OPTISCHER DICKE MIT ALEX, AVHRR UND HIRS]

MARTINA KAESTNER, KARL-THEODOR KRIEBEL, RALF MEERKOTTER, WOLFGANG RINGER, GERHARD RUPPERSBERG, and PETER WENDLING *In its* Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 107-123 Sep. 1991 In GERMAN Original contains color illustrations

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Data from International Cloud Experiment (ICE) on the height and optical depth of cirrus clouds obtained either by the Aircraftborne Aerosol Experiment (ALEX), or by satellite observations, Advanced Very High Resolution Radiometer (AVHRR) and High resolution Infrared Radiation Sounder (HIRS), are compared. It is shown that a 30 percent agreement is to be expected with regard to error estimation. The comparison between satellite data and aircraft observations of derived cloud parameters, shows that satellite data can give quantitative information on the physical properties of clouds. ESA

N92-26347# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

REMOTE SENSING OF ATMOSPHERE WITH AIRCRAFT BORNE LIDAR SYSTEMS (FERNERKUNDUNG DER ATMOSPHERE MIT FLUGZEUGGETRAGENEN LIDARSYSTEMEN)

GERHARD EHRET, WOLFGANG RINGER, UWE ROESLER, CHRISTIAN KIEMLE, GEORG SIMMET, and GERHARD RUPPERSBERG *In its* Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 199-205 Sep. 1991 In GERMAN; ENGLISH summary Original contains color illustrations

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Spatial and temporal distribution of clouds and aerosols are

measured by lidar. Their optical properties are evaluated using additional assumptions. Wind velocities are mapped by backscatter Doppler lidar systems. Raman lidars are to be used for the supervision of factory emissions. It is shown that Differential Absorptions Lidar (DIAL) systems offer considerable physical advantages in measuring atmospheric constituents; experiences with an airborne device are described. ESA

N92-28689# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

ATMOSPHERIC TURBULENCE SPECTRA AND CORRELATION FUNCTIONS

R. NOBACK 13 Jun. 1989 73 p

(Contract OV/RLD-937/1)

(NLR-TP-89217-U; ETN-92-91523) Avail: CASI HC A04/MF A01

The derivation of one, two, and three dimensional spectra and correlation functions for isotropic (atmospheric) turbulence and the mutual relations were collected from various sources. Aircraft loads usually are determined using a one dimensional turbulence description. In some cases, a two or even three dimensional description might be preferable. Aircraft loads can then be determined using two dimensional spectra and cross spectra. These types of spectra are described, and an outline of methods to determine aircraft loads is given. ESA

47

METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

A92-11268

A MICROMETEOROLOGICAL INVESTIGATION OF SURFACE EXCHANGE PARAMETERS OVER HEATHLAND

JAN-WILLEM ERIJSMAN (National Institute of Public Health and Environmental Protection, Bilthoven, Netherlands) and JAN DUYZER (TNO, Delft, Netherlands) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 57, no. 1-2, Oct. 1991, p. 115-128. Research supported by CEC. refs

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An automated system for measuring the dry deposition fluxes of SO₂ on a routine basis based on the micrometeorological gradient technique has been developed for application over grassland and other short vegetation. The ability of the system to determine turbulent exchange parameters such as the friction velocity and the heat flux H was investigated by comparison with an automated eddy correlation system. Determinations friction velocity and H by both methods have generally been found to be in very good agreement for 20 min average. Aerodynamic resistances derived from both systems showed no systematic differences, but individual values differed considerably. From the analysis it appeared that, in addition to classical rejection criteria on wind speed and inhomogeneity, periods with large shifts in wind direction also have to be removed from the data set before interpretation. Author

A92-13336

EVAPORATION AND ENERGY FLUXES IN THE ATMOSPHERIC BOUNDARY LAYER DURING LOTREX

ANNE M. JOCHUM, NORBERT ENTSTRASSER, HANS-P. FIMPEL, PETER MOERL, FRANK ROESLER, and HERMANN WILLEKE (DLR, Institut fuer Physik der Atmosphaere, Oberpfaffenhofen, Federal Republic of Germany) IN: Symposium on FIFE - First ISLSCP Field Experiment, Anaheim, CA, Feb. 7-9, 1990, Preprints. Boston, MA, American Meteorological Society, 1990, p. 177-180. refs

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The atmospheric boundary layer (ABL) is examined in terms of structural characteristics affected by inhomogeneous land use, vegetation, and/or soil, and area-averaged fluxes are determined

by means of several techniques. Aircraft observations of ABL variables are employed to develop vertical profiles of mean parameters, fluxes, and spectral characteristics as well as some horizontal characteristics. The diurnal variation of evaporation and energy fluxes in the ABL are demonstrated by the data analysis, and variations in soil types are found to influence the fluxes.

C.C.S.

A92-13855

THE NEW AIRPORT AERONAUTIC METEOROLOGICAL CODES [LES NOUVEAUX CODES METEOROLOGIQUES AERONAUTIQUES D'AERODROME]

MICHEL REDDAN (Conseil Supérieur de la Météorologie, Boulogne-Billancourt, France) Navigation (Paris) (ISSN 0028-1530), vol. 39, Oct. 1991, p. 544-549. In French.

Copyright

Amendments to the existing airport meteorological codes recently adopted by ICAO and WMO are presented. The new procedures will lend themselves to electronic data processing in a more satisfactory manner and be better suited for precision approach procedures. These new codes will provide clearer international definitions of time, surface winds, visibility, cloud definition, vertical visibility, and temperature/pressure gradients.

R.E.P.

A92-13977

AIRCRAFT MEASUREMENTS AND MODEL COMPARISONS OF WATER VAPOUR CONTINUUM ABSORPTION IN THE 10-12 MICRON (800-1000 PER CM) REGION

C. G. KILSBY, R. W. SAUNDERS, J. S. FOOT (Royal Aerospace Establishment, Farnborough, England), and D. P. EDWARDS (NCAR, Boulder, CO) IN: Conference on Atmospheric Radiation, 7th, San Francisco, CA, July 23-27, 1990, Preprints. Boston, MA, American Meteorological Society, 1990, p. 389-394. refs

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An instrumented C-130 aircraft was deployed from Dakar, Senegal to measure radiances with the multichannel radiometer at viewing angles close to zenith, nadir, and 60 deg from nadir. Simultaneous humidity, temperature, and aerosol data were acquired. Subsequent comparisons with current models permit theory to be tested and provide data for climate studies and remote sensing.

R.E.P.

A92-14052

EXPERIMENTAL STUDY OF THE ATMOSPHERIC MARINE BOUNDARY LAYER FROM IN-SITU AIRCRAFT MEASUREMENTS (TOSCANE-T CAMPAIGN) - VARIABILITY OF BOUNDARY CONDITIONS AND EDDY FLUX PARAMETERIZATION

FREDERIQUE SAID and AIME DRUILHET (Toulouse III, Université, France) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 57, no. 3, Nov. 1991, p. 219-249. Research supported by INSU. refs

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In situ atmospheric aircraft measurements made during the TOSCANE-T experiment organized by ESA to calibrate the scatterometer for launch on the first ESA Remote Sensing satellite ERS-1 for global ocean wind measurements are presented. Data on the thermodynamic and turbulent variables measured by an aircraft flying at a constant level of 50 m over the sea surface are analyzed. The results of the bulk aerodynamic relationships appeared to be scale invariant, justifying the application of average values (within the range of scales under study).

I.S.

A92-16080

LIGHTNING ACTIVITY IN MICROBURST PRODUCING STORM CELLS

P. LAROCHE, C. MALHERBE, A. BONDIUO (ONERA, Chatillon, France), M. WEBER, C. ENGHOLM, and V. COEL (MIT, Lexington, MA) (International Conference on Radar Meteorology, 25th, Paris, France, June 24-28, 1991) ONERA, TP no. 1991-98, 1991, 5 p. Research supported by DRET, Direction Generale de l'Aviation

Civile, and FAA. refs

(ONERA, TP NO. 1991-98)

The paper describes an experiment performed in Orlando (Florida) during the summer of 1990 to investigate the relationships between lightning and weather conditions that are hazardous to aircraft (such as wind shear, turbulence, and heavy precipitation). The experiment used Doppler radars and a two-station lightning detection system. Preliminary results relating the lightning measurements to the cloud evolution are presented.

I.S.

A92-17729

SODAR WIND SPEED PROFILES OVER FORESTED BOUNDARY LAYER DURING THE HAPEX-MOBILHY CAMPAIGN

C. MAZAUDIER (Centre de Recherches en Physique de l'Environnement Terrestre et Planétaire, Saint-Maur-des-Fosses, France), J. BOUVET, and A. WEILL (Centre de Recherches en Physique de l'Environnement Terrestre et Planétaire, Issy-les-Moulineaux, France) Annales Geophysicae (ISSN 0939-4176), vol. 9, Aug. 1991, p. 501-509. refs

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Sodar and minisodar wind speed profiles above two different canopies (forested and clearing site) are analyzed in terms of a logarithmic law. The friction velocities and roughness lengths derived from acoustic sounding data are compared with those derived from radiosounding data or measured by the hydra system. During periods of neutral or quasi-neutral atmospheric stability conditions, the friction velocity estimations are in good agreement whatever the method of measurement (aerodynamic or correlation), the data type (space and time resolution), the parameterization used, or the site area. Below 60 m, the logarithmic law fits the wind profile whatever the atmospheric stability conditions are. The friction velocities deduced from minisodar data are in good agreement with the hydra friction velocities, with an error bar of 20 percent.

Author

A92-17730

THE EFFECTS OF SURFACE INHOMOGENEITIES ON THE SURFACE FLUXES AND ON THE DEVELOPMENT OF THE PLANETARY BOUNDARY LAYER

C. M. J. JACOBS, H. A. R. DE BRUIN, and A. VERHOEF (Agricultural University, Wageningen, Netherlands) Annales Geophysicae (ISSN 0939-4176), vol. 9, Aug. 1991, p. 510-520. Research supported by NWO. refs

(Contract CEC-EV4C-0015-NL)

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A multilayer, 1D Planetary Boundary Layer (PBL) model is coupled to the 'big leaf' vegetation model of Penman-Monteith, and also to a multilayer model for bare soil. The aerodynamic resistance is corrected for stability. The canopy resistance for forests is calculated from environmental variables, while that of grass is taken as constant. The coupled models apply in stable, unstable, and neutral conditions. In general, the models are capable of realistically simulating some well-known features. Within the limits of the use of the 1D approach, the results are comparable to those of mesoscale models. Some examples of the sensitivity of the surface fluxes in the coupled situation to surface parameters are presented. The coupled vegetation - PBL model is also used in a semitrajectory approach in order to study the effects of surface inhomogeneities on the development of the PBL and on the surface fluxes.

Author

A92-18902

MESOSCALE DYNAMICS OF COLD FRONTS - STRUCTURES DESCRIBED BY DROPSOUNDINGS IN FRONTS 87

ALAN J. THORPE and SID A. CLOUGH (Reading, University, England) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 117, pt. B, July 1991, p. 903-941. refs

Data from dropsoundings in Fronts 87 research aircraft are analyzed. Several new aspects of cold-front dynamics are identified from these data. The aircraft flew a pattern with four or five runs oriented approximately at right angles to the front, but with each run displaced in the along-front direction by about 100 km. The

dropsondes gave soundings to a height of approximately 7 km with a cross frontal spacing of 20 km at best and 60 km on average. A minimal and objective analysis of the data is presented, but the high resolution of the dropsonde observations permits the evaluation of differentiated quantities, such as potential vorticity, with some confidence. Issues addressed include the degree of thermal-wind balance, the structure of conserved variables such as equivalent potential temperature and absolute momentum, the cross-frontal circulation, and the role of diabatic processes such as the evaporation of snow, and the potential vorticity structure on the mesoscale and its interpretation. C.A.B.

A92-21196

DECOMPOSING THE ATMOSPHERIC FLOW USING POTENTIAL VORTICITY FRAMEWORK

EERO HOLOPAINEN and JUSSI KAUROLA (Helsinki, University, Finland) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 48, Dec. 15, 1991, p. 2614-2625. refs

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The invertibility principle of potential vorticity (PV) is used, within a quasi-geostrophic framework, to formally partition the observed atmospheric flow in various ways. The first method separates the contributions of the interior PV and temperature at the lower boundary. In the literature, this approach has mainly been applied to some idealized flows. In real situations, however, this partitioning appears questionable because any nonzero temperature anomaly at the boundary automatically implies a nonzero stability part of the interior PV and, hence, these two contributions never occur independent of each other in nature. At large horizontal scales, the two contributions have a large amplitude at every level and almost cancel each other. The second method decomposes the 3D flow into contributions arising from the vorticity and the stability parts of the PV. This formal partitioning appears essentially to decompose the flow into its barotropic and baroclinic part. The third method explores the role of PV of various layers in inducing the flow. This approach shows that the upper-level flow is very little influenced by PV at the lower levels. In the lower troposphere, however, the large-scale flow is dictated by PV in the upper troposphere and lower stratosphere, whereas the smaller-scale features are induced by the local PV, the latter including the effect of the boundary temperature. The third method may be useful as means of verification of atmospheric general circulation models. Author

A92-22607

HOW ACCURATELY CAN WE PREDICT THE ERRORS IN SATELLITE CLOUD-MOTION WINDS?

R. W. LUNNON and D. A. LOWE (Meteorological Office, Bracknell, England) IN: Conference on Satellite Meteorology and Oceanography, 5th, London, England, Sept. 3-7, 1990, Preprints. Boston, MA, American Meteorological Society, 1990, p. 416-420. refs

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The paper discusses the accuracy with which the errors generated in satellite cloud-motion winds (CMWs) can be predicted a priori and the calculations of the correlation between the predicted error and the actual error. Data are presented for the relationship between the quantity and quality for various correlations between the predicted and actual error for SATOBS aircraft reports. Attention is also given to the predictions of the errors in ESA's CMWs. I.S.

A92-22952

IN SITU MEASUREMENTS OF THE ICE WATER CONTENT IN CIRRUS CLOUDS

PHILIP R. A. BROWN (Meteorological Research Flight, Farnborough, England) IN: 1990 Conference on Cloud Physics, San Francisco, CA, July 23-27, 1990, Preprints. Boston, MA, American Meteorological Society, 1990, p. 193-195. refs

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Ice water content (IWC) measurements made using 2D OAP (Optical Array Probe) probes and data from a new total water content probe (TWCP) carried on the C-130 aircraft have been

verified. It is concluded that the major source of error in IWC measurements from TWCP is the zero-humidity offset in its calibration. O.G.

A92-22994

A DEEP CONVECTIVE CLOUD MODEL WITH EXPLICIT MICROPHYSICS INCLUDING THE ICE PHASE

S. H. VAN DER VEEN (Utrecht, State University, Netherlands) IN: 1990 Conference on Cloud Physics, San Francisco, CA, July 23-27, 1990, Preprints. Boston, MA, American Meteorological Society, 1990, p. 633-637. refs

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A 2D cloud model is described in terms of the equations for cloud dynamics and microphysical processes relating to the liquid phase and drop breakup by collisions vs spontaneous action. The ice-phase microphysics are considered analytically for individual ice crystals, snowflakes, and graupel particles, as well as six hydrometeor interactions: crystal-crystal, crystal-snowflake, snowflake-snowflake, crystal-graupel, etc. The equations also account for melting and particle fall velocities, and the 2D model is thus considered to be explicit and complete. C.C.S.

A92-25198

DERIVATION OF THE AERODYNAMIC ROUGHNESS PARAMETERS FOR A SAHELIAN SAVANNAH SITE USING THE EDDY CORRELATION TECHNIQUE

C. R. LLOYD, J. H. C. GASH (Institute of Hydrology, Wallingford, England), and M. V. K. SIVAKUMAR (International Crops Research Institute for the Semi-Arid Tropics, Niamey, Niger) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 58, Feb. 1992, p. 261-271. Research supported by Overseas Development Administration and NERC. refs

Copyright

Vertical exchange of heat, moisture and momentum above the earth's surface depends strongly on the turbulence generated by surface roughness. This roughness is best specified through the roughness length and the zero plane displacement. The ratio of windspeed to friction velocity was measured at four heights using the eddy correlation technique at a fallow savannah site in the Sahel. The change in this ratio with height was used to derive the zero plane displacement and the roughness length of the surface, together with an estimate of the error in each parameter. These were estimated as 0.93 +/- 0.35 m and 0.17 +/- 0.01 m, respectively. The method appears to be a more robust alternative to wind profile derivation. Author

A92-27796

ON THE RELATION BETWEEN TOTAL OZONE AND METEOROLOGY

G. VAUGHAN and J. D. PRICE (University College of Wales, Aberystwyth) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 117, Oct. 1991, p. 1281-1298. refs

A relationship is derived between absolute vorticity in the lower stratosphere and the total-ozone column. This relationship shows that reversible deformations to the flow in the lower stratosphere on synoptic scales or smaller (such as trough/ridge patterns) cause perturbations in total ozone which depend on the amplitude and depth of the vorticity anomaly. Examples are presented showing excellent correspondence between total ozone and vorticity charts, even on mesoscales. Grid correlations show that at least half the variance in total ozone is related to variations in the vorticity just above the tropopause. Some applications of the ozone-vorticity relationship are discussed. Author

A92-27800

COMMENTS ON 'LARGE-EDDY SIMULATION OF THE UP-SLOPE BOUNDARY LAYER' BY ULRICH SCHUMANN (APRIL 1990, 116, 637-670)

I. VERGEINER (Innsbruck, Universitaet, Austria) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 117, Oct. 1991, p. 1371, 1372; Author's Reply, p. 1373, 1374. refs

A92-32487

A MOST BEAUTIFUL POLAR LOW - A CASE STUDY OF A POLAR LOW DEVELOPMENT IN THE BEAR ISLAND REGION
 THOR E. NORDENG (Norwegian Meteorological Institute, Oslo, Norway) and ERIK A. RASMUSSEN (Copenhagen, University, Denmark) Tellus, Series A - Dynamic Meteorology and Oceanography (ISSN 0280-6495), vol. 44A, March 1992, p. 81-99. refs

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Satellite images from 26 and 27 February 1987 of the Bear Island region show the formation of a polar low with an unusual symmetric cloud field around a central eye, which strongly resembles a small-scale tropical storm. Conventional observations as well as output from a limited area numerical model are scrutinized to understand the dynamics of the low and to determine whether the development and structure of the polar low actually corresponds to that of a tropical cyclone. The discussion is based upon potential vorticity arguments. The data shows that the analogy between this particular polar low and tropical storms is not limited to the structure of the cloud field. However, the low develops in a baroclinic environment and is triggered by an upper-level potential vorticity anomaly. The upper level forcing diminishes after the initial triggering phase. The possibility of a self-induced development during the maintenance phase from the release of latent heat is discussed.

Author

A92-32489

A COMPARISON OF SATELLITE SOUNDING DATA AND AIRCRAFT MEASUREMENTS WITHIN A MATURE POLAR LOW

J. TURNER, T. A. LACHLAN-COPE, and J. C. MOORE (NERC, British Antarctic Survey, Cambridge, England) Tellus, Series A - Dynamic Meteorology and Oceanography (ISSN 0280-6495), vol. 44A, March 1992, p. 119-132. refs

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The value of satellite temperature sounding data in polar lows research is investigated through a comparison of satellite temperature profiles produced using radiances from the Tiros Operational Vertical Sounder (TOVS) and in situ measurements from the first aircraft observations made within a mature polar low. The soundings are also compared to the ECMWF analyses to see how they represent the broadscale thermal field. The TOVS 1000-500 mb thickness data were found to be capable of resolving the main thermal features associated with the system including a warm core at the center of the vortex. The 1000 and 500 mb temperature fields and thermal gradients were comparable in the two forms of data. A low-level temperature bias was found in the TOVS retrievals and was thought to have been caused by the small signal of the near surface adiabatic lapse rate in the TOVS channels.

Author

A92-32490

POLAR LOWS AND ARCTIC INSTABILITY LOWS IN THE BEAR ISLAND REGION

ERIK A. RASMUSSEN (Copenhagen, University, Denmark), TORBEN S. PEDERSEN (Danish Meteorological Institute, Copenhagen, Denmark), LEIF T. PEDERSEN (Technical University of Denmark, Lyngby), and JOHN TURNER (NERC, British Antarctic Survey, Cambridge, England) Tellus, Series A - Dynamic Meteorology and Oceanography (ISSN 0280-6495), vol. 44A, March 1992, p. 133-154. Research supported by Greenland Sea Project. refs

(Contract N00014-87-G-0232)

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The study of the 'polar low episode' over the northern parts of the Norwegian Sea and the Barents Sea from 12 December 1982 to 16 December 1982 is continued. The role of baroclinic instability in the initial formation of a polar low near the ice edge is considered, including a discussion based on a diagnostic IPV analysis. During the polar low episode, circulations develop on different horizontal scales including true mesoscale phenomena. The mesoscale circulations have the character of symmetric vortices of a much smaller horizontal scale, about 100 km, than

normally associated with polar lows. Although, during their initial formation, these circulations may be modulated by baroclinic instability associated with a shallow arctic frontal zone, they are predominantly convectively driven. The term 'arctic instability lows' is suggested for these disturbances in order to distinguish them from the more 'normal' polar lows. The polar low formations take place within a large synoptic scale cold dome. The importance of this cold dome as well of cold domes in general for polar low formations is briefly discussed.

Author

A92-32491

POLAR LOWS AFFECTING DENMARK

PETER D. AAKJÆR (Danish Meteorological Institute, Copenhagen, Denmark) Tellus, Series A - Dynamic Meteorology and Oceanography (ISSN 0280-6495), vol. 44A, March 1992, p. 155-172. refs

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Eighteen cases of polar lows (subsynchronous cold air vortices) over Denmark in the 10 polar low seasons (November to April) from 1980-90 have been analyzed. The different properties of the lows are discussed and examples are shown illustrating the variety of the lows ranging from relatively strong, rapidly developing, baroclinic disturbances down to weak lows of the horizontal scale of 100 km forming out of a small group of cumulonimbus clouds. They generally form in an almost moist adiabatic atmosphere with preexisting large-scale positive vorticity, and it is suggested that this can explain why polar lows can have a horizontal scale down to 100 km and at the same time be stable systems persisting for several days. The strongest lows are found to have a strong baroclinic influence, but it is shown by using the model proposed by Craig and Cho (1988), that for most of the lows both baroclinic and convective processes can be of importance.

Author

A92-38383

AVIATION METEOROLOGY

FRANK DALTON (Meteorological Office, Bracknell, England) Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 252-257.

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A review of weather-related aviation operations shows that despite the introduction of modern avionics on board the aircraft, and automated instrumentation on the ground assisting airfield operations, weather, is still and will continue to be, a vital part of aircraft operations decision-making, affecting the safety and efficiency of flight. New improved communication services will become available in the future so that aircrews can be fully informed both before their flight, and also in the air, and vital information from the aircraft can be relayed rapidly back to the meteorologist. Increasing air movements with reduced air separations require closer management of flights with up-to-the-minute advice of weather hazards, as well as very accurate temperature and wind information regularly updated.

R.E.P.

A92-39471

A THEORETICAL TEST OF THE GEOSTROPHIC MOMENTUM APPROXIMATION

T. S. SPASOVA (Bulgarian Academy of Sciences, Institute of Meteorology and Hydrology, Sofia, Bulgaria) Advances in Atmospheric Sciences (ISSN 0256-1530), vol. 9, no. 2, May 1992, p. 251-255. refs

Copyright

The geostrophic momentum approximation (GMA) is examined to assess its accuracy by comparing the solution to that of a 2D air flow with constant horizontal shear. The GMA is found to underestimate the dimensionless vorticity and to present simplified solutions, but the GMA gives satisfactory results when the H-field is circularly symmetrical. In general the approximate and exact solutions are notably different.

C.C.S.

A92-47345

THE SENSITIVITY OF REGIONAL TRANSPIRATION TO LAND-SURFACE CHARACTERISTICS - SIGNIFICANCE OF FEEDBACK

C. M. J. JACOBS and H. A. R. DE BRUIN (Agricultural University, Wageningen, Netherlands) *Journal of Climate* (ISSN 0894-8755), vol. 5, no. 7, July 1992, p. 683-698. Research supported by NWO. refs
Copyright

Several authors have determined the sensitivity of transpiration to different environmental parameters using the Penman-Monteith equation. In their studies, the interaction between transpiration and, for example, the humidity of the air is ignored: the feedback with the planetary boundary layer (PBL) is not accounted for. Furthermore, surface-layer (SL) feedback (e.g., stability effects in the surface layer) is often neglected. In this study, both PBL feedback and SL feedback are accounted for by coupling the big-leaf model to a detailed model for the PBL. This study provides an analysis of the sensitivity of transpiration to net radiation calculated after an albedo change, aerodynamic resistance calculated after a change in the aerodynamic roughness, and surface resistance. It is shown that PBL feedback affects the sensitivity of transpiration to the tested variables significantly. The sensitivity of transpiration to surface resistance and to aerodynamic resistance, or aerodynamic roughness, is decreased by the PBL feedback. In contrast, PBL feedback enlarges the sensitivity of transpiration to the net radiation, or albedo, and appears to be highly dependent on the specific conditions, especially on the aerodynamic roughness of the vegetation. Author

A92-47733

THE COUPLING BETWEEN RADIATION AND DYNAMICS IN THE STRATOSPHERE

A. O'NEILL (Oxford, University, England) and V. D. POPE (Hadley Centre for Climate Prediction and Research, Bracknell, England) (Middle and upper atmosphere results; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C2 and C3/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-47701 20-46) *Advances in Space Research* (ISSN 0273-1177), vol. 13, no. 1, Jan. 1993, p. 351-358. refs
Copyright

A numerical simulation of the annual cycle of the middle atmosphere is used to diagnose the coupling between radiation and dynamics in the stratosphere with particular attention to Canadian warmings and major warmings. The diagnosis is based on an adaptation of Kelvin's circulation theorem, which yields an expression for the time derivative of a circulation integral taken around isopleths of potential vorticity on an isentropic surface. Departures from radiative equilibrium produced by persistent planetary-scale disturbances in late winter lead to systematic changes in circulation integrals, which reflect systematic changes in the average distribution of potential vorticity. The main findings is that radiation is a prime contributor to the changes in circulation integrals that are characteristic of the formation in late winter of a main vortex/surf-zone structure. Author

A92-47734

THE EFFECTS OF RESOLUTION ON DIAGNOSTIC CALCULATIONS OF COUPLING BETWEEN RADIATION AND DYNAMICS

A. O'NEILL (Oxford, University, England) and V. D. POPE (Hadley Centre for Climate Prediction and Research, Bracknell, England) (Middle and upper atmosphere results; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C2 and C3/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-47701 20-46) *Advances in Space Research* (ISSN 0273-1177), vol. 13, no. 1, Jan. 1993, p. 359-362. refs
Copyright

Measurements by the satellite-borne SSU and LIMS instruments are used to infer that circulation integrals around isopleths of potential vorticity of an isentropic surface can be computed with good precision from satellite data. An equation for the time derivative of a circulation integral involves a radiative term. When derived from SSU data, this term exhibits a marked positive bias with respect to the time derivative, a main cause of which is the

limited vertical resolution of the SSU. When this bias is allowed for, the observational results support a conclusion reached in a companion paper, namely, that radiation is a major contributor to the formation of a main vortex/surf-zone in the average distribution of potential vorticity. Author

A92-49771

A COMPARISON OF MEASURED AND MODELED BROADBAND FLUXES FROM AIRCRAFT DATA DURING THE ICE '89 FIELD EXPERIMENT

R. W. SAUNDERS (Meteorological Office, Farnborough, England), G. BROGNEZ, J. C. BURIEZ (Lille I, Université, Villeneuve d'Ascq, France), R. MEERKÖETTER, and P. WENDLING (DLR, Institut fuer Physik der Atmosphaere, Oberpfaffenhofen, Federal Republic of Germany) *Journal of Atmospheric and Oceanic Technology* (ISSN 0739-0572), vol. 9, no. 4, Aug. 1992, p. 391-406. Research supported by CEC. refs
Copyright

During the 1989 intensive field campaign of the International Cirrus Experiment over the North Sea, broadband radiative fluxes were measured in, above, and below cirrus cloud by a number of European meteorological research aircraft. One mission during the campaign was an intercomparison flight in clear air with no cloud above in order to compare, among other things, radiative flux measurements made by the U.K. C-130, the French Merlin, and the German Falcon aircraft. All three aircraft measured shortwave flux (0.3-3 microns) with standard Eppley pyranometers above and below the fuselage. The intercomparison showed agreement between the three aircraft of within 2 percent for both the upwelling and downwelling shortwave flux components. Using a coincident temperature and humidity radiosonde profile, the downwelling clear-sky fluxes at the level of the aircraft were also calculated using a variety of different radiation models. Modeled shortwave fluxes were all higher than the measured values. In addition to shortwave fluxes the C-130 and Merlin also measured near-infrared fluxes by having additional Eppley pyranometers mounted with red domes over the thermopiles. The near-infrared fluxes measured by the Merlin and C-130 were different because slightly different red-dome filters were used; model calculations show the difference between the measured fluxes was consistent with the different pass band of the filters. Infrared fluxes were measured using standard Eppley pyrgeometers on the Falcon and pyrgeometers developed at the Meteorological Research Flight on the C-130; comparisons show no significant differences for the downwelling fluxes but the Falcon upwelling fluxes were 7 percent higher than the corresponding C-130 values. This latter difference is higher than would be expected for these instruments. The modeled infrared fluxes were up to 9 percent lower than the C-130 and Falcon measurements. Author

A92-51781

THE ROLE OF DIFFUSIVE EFFECTS ON POTENTIAL VORTICITY IN FRONTS

IAIN M. COOPER, ALAN J. THORPE, and CRAIG H. BISHOP (Reading, University, United Kingdom) *Royal Meteorological Society, Quarterly Journal* (ISSN 0035-9009), vol. 118, no. 506, June 1992, p. 629-647. refs
(Contract NERC-GR/3/6920)

The role of surface fluxes and the internal mixing of heat and momentum in producing local potential vorticity (PV) anomalies, and in changing the mass-weighted volume-average PV in developing, and ultimately occluding, frontal systems is investigated. Particular attention is paid to the relative timings of the increase of the mass-weighted volume-average PV and the point of occlusion of the wave. The bulk formation for surface fluxes of heat and momentum is used to illustrate the general role of boundary-layer processes in modifying PV locally. Turbulent fluxes which decrease linearly from maximum values at the surface to zero at the top of the PBL are used to recover a simple analytical form for the PV generation tendency. It is shown that the generation of PV in the PBL depends on the vertical differences of velocity and potential temperature over the depth of the PBL and on the

vertical vorticity and horizontal potential-temperature gradient at the top of the PBL. P.D.

A92-51783

FOUR-DIMENSIONAL DATA ASSIMILATION - COMPARISON OF VARIATIONAL AND SEQUENTIAL ALGORITHMS

MARTIN EHRENDORFER (Wien, Universitaet, Vienna, Austria) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 118, no. 506, June 1992, p. 673-713. refs

Results are presented of a series of observing-systems simulation experiments performed to investigate the comparative performance of the global 4D variational (4DVAR) data assimilation algorithm and the sequential extended Kalman filter (EKF) algorithm. Both methods provide an internally consistent, and conceptually simple, approach to the problem of data assimilation, as both allow for a high degree of generality in choosing the assimilating model, the link operator between model state and observations, and incorporation of observational-error statistics. It is found that for reasonably over-determined problems and uniform global data coverage both assimilation algorithms yield the same assimilation errors for the end of the assimilation interval. Increasing the length of the assimilation interval results in an equal decrease of the assimilation errors of both methods. Whereas the equal performance of both assimilation algorithms for uniform global data coverage is insensitive to the information content given to the first guess chosen to initialize the EKF, consideration of an increasing information content of the first guess in both algorithms for more sparsely and unevenly distributed data has a positive effect on the EKF results, but a rather negligible effect on the 4DVAR results. P.D.

A92-51784

WATER-VAPOUR CONTINUUM ABSORPTION IN THE TROPICS - AIRCRAFT MEASUREMENTS AND MODEL COMPARISONS

C. G. KILSBY (Meteorological Office; Royal Aerospace Establishment, Farnborough, United Kingdom), D. P. EDWARDS (NCAR, Boulder, CO), R. W. SAUNDERS, and J. S. FOOT (Meteorological Office; Royal Aerospace Establishment, Farnborough, United Kingdom) Royal Meteorological Society, Quarterly Journal (ISSN 0035-9009), vol. 118, no. 506, June 1992, p. 715-748. refs

Measurements of water-vapor continuum absorption in the 10-12-micron window have been made in the tropical atmosphere using a multichannel narrow field-of-view radiometer mounted on an aircraft. Comparisons with two radiative transfer models (GENLN 2 and LOWTRAN 7) are made which show that the model underestimates the absorption by some 30 percent. Two methods of modifying the existing empirical continuum parameterization to obtain better agreement with the aircraft measurements are assessed: one involves increasing the self-broadened absorption coefficient, the other increasing the temperature-dependence parameter. Author

A92-52354

SULFUR EMISSION, CCN, CLOUDS AND CLIMATE - A REVIEW

Y. FOUQUART (Lille I, Universite, Villeneuve d'Ascq, France) and H. ISAKA (Clermont-Ferrand II, Universite, Aubiere, France) Annales Geophysicae (ISSN 0992-7689), vol. 10, no. 7, July 1992, p. 462-471. Research supported by EEC. refs Copyright

Attention is given to the relationship between atmospheric sulfur concentration and cloud condensation nuclei (CCN) concentration, the extent to which CCN concentration and the number of cloud droplets are related, and the magnitude of the expected effect on the planetary albedo. The physical basis for the climatic effect of CCN variations, i.e., the variations in radiative properties directly or indirectly associated with variations in droplet size, is considered. Satellite and aircraft observations of enhanced cloud reflectivities in the tracks of ships' exhausts confirm that, at least in some cases, changes in CCN concentration do have a significant impact on cloud albedos. Under some conditions, more

CCN lead to more droplets, to smaller droplets, and to increased cloud reflectivity. It is suggested that cloud liquid water may vary in relation to droplet number. With regard to the causes of variation of CCN number over oceanic areas, the relative importance of biogenic and anthropogenic sulfur sources is geographically dependent; sulfur constituents are essentially anthropogenic. C.A.B.

A92-52594

AMPLIFICATION AND MERIDIONAL CONFINEMENT OF STATIONARY AND QUASI-STATIONARY EDDIES IN A TWO-LAYER MODEL

ROBERTO BENZI (Roma II, Universita, Rome, Italy) and PIERO MALGUZZI (CNR, Istituto per lo Studio dei Fenomeni Fisici e Chimici della Bassa e Alta Atmosfera, Bologna, Italy) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 49, no. 17, Sept. 1, 1992, p. 1585-1593. Research supported by EEC. refs Copyright

The problem of resonance and meridional confinement of planetary-scale waves is investigated in the framework of a quasi-geostrophic, two-layer, beta-plane model with lateral sponge layers. It is shown that the model resonant wavenumber is meridionally confined despite the predictions of the linear barotropic theory based on the time-mean zonal wind. As a consequence, the fully nonlinear model exhibits a resonant response to orographic forcing significantly higher than that predicted by the linearized (baroclinic) version of the model itself. The model response to a localized (zonally and meridionally) orography is also studied and found to be consistent with previous results observed in spherical geometry. The significance of this result and the mechanisms leading to meridional confinement are discussed. It is suggested that nonlinearity and the inverse energy cascade process are responsible for the observed, enhanced wave confinement. Author

A92-52941

LOCAL ERROR GROWTH IN A BAROTROPIC MODEL

JAN BARKMEIJER (Royal Netherlands Meteorological Institute, De Bilt) Tellus, Series A - Dynamic Meteorology and Oceanography (ISSN 0280-6495), vol. 44A, no. 4, Aug. 1992, p. 314-323. refs Copyright

The concept of local error growth is considered within the context of the nonviscous barotropic vorticity equation. Using the adjoint equation of the tangent linear barotropic vorticity equation, error patterns in the initial state that result in the maximum linear error growth at some prechosen geographical area and prediction time are determined. For some solutions of the nonlinear barotropic vorticity equation, an investigation is conducted as to what extent error growth depends on the geographical position of the area considered. It appears that for short prediction times (less than 3 days), the barotropic growth of kinetic energy of initial perturbations is exponential plus a substantial transient effect due to the nonorthogonality of the eigenmodes of the tangent linear operator with respect to the kinetic energy inner product. The latter mechanism initially causes very rapid perturbation growth, even for neutral flows. Author

A92-53349

THE USE OF CONSERVATIVE COORDINATES FOR RECONSTRUCTION TECHNIQUES AND FOR THE DEVELOPMENT OF A TWO-DIMENSIONAL TRANSPORT MODEL

G. REDAELLI, G. PITARI, and G. VISCONTI (L'Aquila, Universita, Italy) Nuovo Cimento C, Serie 1 (ISSN 0390-5551), vol. 15 C, no. 3, May-June 1992, p. 351-355. refs Copyright

A technique is described for reference-frame transformation to develop a Lagrangian 2D model for the study of tracer transport. The reference-frame transformation bridges the change from 3D space to potential-temperature/potential-vorticity space and can be used to analyze and reconstruct experimental data. The method is shown to be useful in the study of the polar stratospheric vortex without the use of large-scale eddy mixing. C.C.S.

N92-17853 ESDU International Ltd., London (England). **MEAN WIND SPEEDS OVER HILLS AND OTHER TOPOGRAPHY**

Dec. 1991 41 p
(ISSN 0143-2702)

(ESDU-91043; ISBN-0-85679-805-3) Avail: ESDU

ESDU 91043 presents methods for estimating speed-up factors for mean wind speeds over hills, embankments, escarpments, and valleys. The methods treat all regions of a hill, including shelter regions near the foot and account for the local profile. Three-dimensional effects and wind inclination to the ridge line can be taken into account. Interference effects from other nearby topography can be assessed, and guidance is provided for the effects of flow separation on steep topography. Two methods are given: a simple graphical approach that is accurate for simple embankments but is less accurate for rounded hills because it only accounts for the overall shape, and a more precise method that accounts for the detailed shape of the hill. Irregularly-shaped hills with bulges and depressions, and multiple hills, are treated by the method of superposition, that is, each irregularity is treated as a separate isolated hill or valley and the contribution to speed up added to the other contributions for an overall solution. The methods were derived from data obtained using solutions of the Navier-Stokes equations, calibrated against both full-scale and wind-tunnel measurements.

Author

N92-18911# World Meteorological Organization, Geneva (Switzerland).

COMMISSION FOR AERONAUTICAL METEOROLOGY. ABRIDGED FINAL REPORT OF THE NINTH SESSION

1991 182 p Session held in Montreal, Quebec, 5-28 Sep. 1990

(WMO-752; ISBN-92-63-10752-1; ETN-92-90660) Copyright Avail: CASI MF A02; HC available from WMO, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

Various aspects of aeronautical meteorology are addressed. Training of aeronautical meteorological personnel, publications and guidance material, and cooperation with other international organizations are discussed. The resolutions and recommendations of the commission are presented. These include recommendations from the advisory working group of the commission, from the working group on advanced techniques, and from the working group on the provision of meteorological information required before and during flight. A complete list of participants is listed in the annex.

ESA

N92-26335# Technische Univ., Munich (Germany). Inst. fuer Meteorologie.

THE STABILITY OF BAROTROPIC VORTICES: IMPLICATIONS FOR TROPICAL CYCLONE MOTION

HARRY C. WEBER and ROGER K. SMITH /In DLR, Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 51-63 Sep. 1991
(Contract N00014-90-J-1487)

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

The existence of normal mode perturbations to barotropic vortices defined by tangential velocity profiles used in studies of tropical cyclone motion is investigated. For this purpose, a method to search systemically for the eigensolutions is developed. No unstable modes were found for relatively broad vortices, but a single neutral mode with zero frequency exists. One relatively narrow profile was found to have an unstable wavenumber two mode. The implications concerning vortex motion in nondivergent, barotropic models relevant to tropical cyclones are discussed.

ESA

N92-26342# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

PRECIPITATION FORMATION PROCESSES IN CONVECTIVE AND STRATIFORM CLOUDS AS DEDUCED BY COORDINATED POLARIMETRIC RADAR AND AIRCRAFT MEASUREMENTS

PETER MEISCHNER, MARTIN HAGEN, and HARTMUT HOELLER /In its Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 141-149 Sep. 1991 Original contains color illustrations
Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

For two different case studies, an upslope situation and a multicell hailstorm, the processes of precipitation formation were analyzed using radar, Doppler, polarimetric and coordinated aircraft measurements. In the upslope situation, low density pristine dendrites were formed. Subsequent riming of these particles during their fallout resulted in irregular shapes and a tumbling fall behavior. The hail formation in the thunderstorm studied was connected with recirculations of graupels and raindrops into the main updraft of the storm.

ESA

N92-26348# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

THE DLR METEOROLOGICAL RESEARCH AIRCRAFT FALCON

HANS P. FIMPEL /In its Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 207-213 Sep. 1991

Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

The Dassault Falcon 20E, used as a platform for atmospheric research, is described. The meteorological instrumentation is presented. Indications, obtained by intercomparison flights, on the high quality of the data are given.

ESA

N92-29300*# GEC-Marconi Ltd., Borehamwood (England). **THE E-BEAM SUSTAINED LASER TECHNOLOGY FOR SPACE-BASED DOPPLER WIND LIDAR**

M. J. BROWN, W. HOLMAN, R. J. ROBINSON, P. M. SCHWARZENBERGER, I. M. SMITH, S. WALLACE, M. R. HARRIS (Defence Research Agency, Malvern, England), D. V. WILLETT (Defence Research Agency, Malvern, England), and S. C. KURZIUS (Lockheed Missiles and Space Co., Huntsville, AL.) /In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 269-272 Jul. 1992
Avail: CASI HC A01/MF A04

An overview is presented of GEC Avionics activities relating to the Spaceborne Doppler Wind Lidar. In particular, the results of design studies into the use of an e-beam sustained CO₂ laser for spaceborne applications, and experimental work on a test bed system are discussed.

Author

N92-31037*# Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.

AIRBORNE LIDAR AND RADIOMETRIC OBSERVATIONS OF PBL- AND LOW CLOUDS

P. H. FLAMANT, R. VALENTIN, and J. PELON (Paris VI Univ., France) /In NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 471-473 Jul. 1992
Avail: CASI HC A01/MF A03

Boundary layer- and low altitude clouds over open ocean and continent areas have been studied during several field campaigns since mid-1990 using the French airborne backscatter lidar LEANDRE in conjunction with on-board IR and visible radiometers. LEANDRE is an automatic system, and a modification of the instrumental parameters, when airborne, is computer controlled through an operator keyboard. The vertical range squared lidar signals and instrument status are displayed in real time on two dedicated monitors. The lidar is used either down- or up-looking while the aircraft is flying above or below clouds. A switching of

the viewing configuration takes about a minute. The lidar measurements provide a high resolution description of cloud morphology and holes in cloud layers. The flights were conducted during various meteorological conditions on single or multilayer stratocumulus and cumulus decks. Analysis on a single shot basis of cloud top (or bottom) altitude and a plot of the corresponding histogram allows one to determine a probability density function (PDF). The preliminary results show the PDFs for cloud top are not Gaussian and symmetric about the mean value. The skewness varies with atmospheric conditions. An example of results recorded over the Atlantic ocean near Biarritz is displayed, showing: (1) the range squared lidar signals as a function of time (here 100 s corresponds to about 8 km, 60 shots are averaged on horizontal); the Planetary Boundary Layer (PBL) - up to 600 m - is observed at the beginning of the leg as well as on surface returns, giving an indication of the porosity; (2) the cloud top altitude variation between 2.4 to 2.8 km during the 150 to 320 s section; and (3) the corresponding PDF. Similar results are obtained on stratocumulus over land. Single shot measurements can be used also to determine an optical porosity at a small scale as well as a fractional cloudiness at a larger scale. A comparison of cloud top altitude retrieved from lidar and narrowbeam IR radiometer is conducted to study the scale integration problem. A good agreement within less than 100 m relies on spatial uniformity and an optically thick layer. In the presence of holes, a discrepancy is observed. This is illustrated in figure 2, displaying as a function of time (1) the lidar signals; (2) the target temperature (either clouds or sea surface) retrieved from a narrowbeam IR radiometer, 17 C is the sea surface temperature on that day; and (3) the visible flux, linked to cloud albedo, measured by a pyranometer. In preparation of ASTEX, down- and up-looking measurements were conducted on stratocumulus clouds over the Atlantic Ocean near Quimper in Brittany. Depending on the flight pattern orientation with respect to the wind, the top and bottom cloud morphologies are different. Preliminary results are given on cloud morphology, cloud top PDFs, optical porosity, fractional cloudiness, and comparison of lidar and radiometric measurements. Author

**N92-31106*# BMW-A.G., Munich (Germany, F. R.).
DENSE FOG ON THE HIGHWAY: VISUAL RANGE
MONITORING IN CARS?**

W. HAHN, W. KRICHBAUMER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), J. STREICHER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.), and CH. WERNER (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) / In NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 727-730 Jul. 1992
Avail: CASI HC A01/MF A03

This paper reports on the development of a new sensor. Laser range-finders are currently installed in cars and trucks to measure the distance to a proceeding car (LEICA). A modification of such a sensor to measure visibility was made. The problems that had to be solved were: (1) choice of wavelength with relation to the human eye for visibility measurements; (2) dependency of the wavelength on atmospheric turbidity; (3) laser eye-safety; and (4) influence of multiple scattering at visibilities smaller than 200 m. The wavelength used for lidar sensors in the near infrared presents no real problems because the object to be sensed is fog appearing white which means that scattering from fog is wavelength independent. There are however differences in back-scatter-to-extinction ratio for different fog and weather situations. The two solutions to these problems are polarization and multiple scattering. As known from airport operations of a laser ceilometer, one can use this multiple scattering contribution to determine the visibility. Author

**N92-33969 Nottingham Univ. (England).
REMOTE SENSING OF SEASONAL VARIATIONS IN ALBEDO
OVER SOUTHERN BRITAIN Ph.D. Thesis**
ALLAN R. JAMES 1990 437 p
Avail: Univ. Microfilms Order No. BRD-93841

This research attempted to investigate the applicability of satellite derived data for measuring surface albedo, to investigate the relationship of surface albedo to land cover and land class, and to measure seasonal and episodic variations in surface albedo. Results from satellite mounted narrow-band radiometers, (AVHRR), were contrasted with comparable results obtained from broad-band aircraft mounted pyranometers. Results were found to be comparable provided recognizable atmospheric and geometric limits were not exceeded. Seasonal variations in the surface albedo of specific vegetation classes were monitored and the results used to estimate the seasonal variation of surface albedo over the lowlands of England and Wales. It was found that agricultural areas which have exposed a large area of bare soil for part of the growing season, exhibited a greater variation of surface albedo, (of approx. 0.02), throughout that growing season than did grassland areas. At the country scale this translated into a greater change over the growing season in the surface albedo of the south and east of England than in the predominantly grassland areas of West England and Wales. Throughout the growing season there was a characteristic pattern of vegetated areas consisting of mixed grassland and arable with a decrease in albedo in late spring leading to a rise and peak in mid-summer, a rapid fall in early autumn to a seasonal minimum and ending in a steady increase in late autumn to the seasonal average. This pattern resulted from a combination of seasonal variations in agricultural practices and changes in vegetation morphology. The results showed that within definable limits, satellite derived values could be used to calculate the surface albedo of vegetated surfaces at the scale of 100 sq. km or more. The variation in these results was largely a result of the inability of the atmospheric correction program to accurately model the true atmosphere, and to the difficulty in obtaining a broad-band surface albedo value from narrow-band radiometer data. The assumption of a Lambertian surface was also expected to reduce the final accuracy of the results. Dissert. Abstr.

**N92-70048 British Library Lending Div., Boston Spa (England).
Meteorological Office.**

**THE FIELD OF POTENTIAL VORTICITY DURING THE
DEVELOPMENT OF A CYCLONE**

E. KLEINSCHMIDT and G.-M. PETER 23 Sep. 1991 16 p
Transl. into ENGLISH from Beitr. Phys. Atmos., Braunschweig (Fed. Republic of Germany), no. 42, 1969 p 67-78
(BLL-MO-TRANS-1705(5733.360)) Avail: CASI HC A03

According to simple theoretical considerations it is a necessary and sufficient condition for cyclogenesis that potential vorticity increases in a completely bounded air mass. Potential vorticity in the central part of the cyclone is found to increase greatly in the particular case studied here. Everything indicates that this increase is due to the condensation of water vapour in the region of upgliding motion. The analysis shows that the origin of a tropopause funnel developing in connection with the surface cyclone is at least partly due to diabatic cooling in the middle troposphere. Author

OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

**A92-12278
ACCURATE CURRENT MEASUREMENT USING DROGUED
BUOYS EMPLOYING DECCA NAVIGATOR AND ARGOS**
EMYR ROBERTS, DAVID LAST (North Wales, University College, Bangor, Wales), and GWYN ROBERTS (Industrial Development Bangor /UCNW/, Ltd., Wales) IEEE Journal of Oceanic Engineering (ISSN 0364-9059), vol. 16, Oct. 1991, p. 307-312. refs

(Contract NERC-GST/02/271)

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Free-floating drogued buoys have been developed for detailed studies of tidal processes, frontal circulation, eddies, and mixing in the North Sea. They are equipped with two independent tracking systems-Decca Navigator and Argos. Decca Navigator, a hyperbolic radio navigation system with extensive coverage in Western Europe, provides accurate and frequent fixes, and the Argos satellite system is used to monitor progress in real time and to assist recovery. The low power consumption microprocessor-based Decca Navigator receiver designed specifically for this application synchronizes to the precisely timed Decca transmission and then goes into sleep mode, waking briefly at 10-min intervals to take position fixes. The position data are stored in a 2-Mb memory card that has a three-month capacity at the 10-min rate. The recovery procedure, using both Argos and a small VHF beacon, is described, together with other recent developments. A typical buoy track from a study in the North Sea is included. I.E.

A92-34878

COMPARISON OF AIRCRAFT SYNTHETIC APERTURE RADAR AND BUOY SPECTRA DURING NORCSEX '88

C. L. RUFENACH, R. A. SHUCHMAN (Michigan, Environmental Research Institute, Ann Arbor), and J. A. JOHANNESSEN (Nansen Environmental and Remote Sensing Center, Bergen, Norway) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 129-132. refs

(Contract N00014-81-C-0692)

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Aircraft synthetic-aperture-radar (SAR) measurements from seven flight paths at two different altitudes were acquired over a trimodal ocean wave system off the coast of Norway on March 11, 1988. The seven flight paths, in conjunction with the three wave systems, resulted in a nearly uniform distribution of azimuth peak directions varying from 0 to 83 deg and R/V varying from 28 to 100. The SAR derived and buoy peak wavelength and direction comparison show some scatter and bias. The scatter is thought to be primarily due to the statistical uncertainty in the spectral estimates, the wavenumber resolution, and differences in the temporal and spatial averaging. Scanning distortion, in addition to other SAR motions effects, can result in significant bias in the image wave systems. I.E.

A92-34943

CHARACTERIZATION OF AIR-ICE-OCEAN INTERACTIVE PROCESSES IN THE MIZ BASED ON SAR DERIVED ICE EDGE CONFIGURATIONS

JOHNNY A. JOHANNESSEN, OLA M. JOHANNESSEN, STEIN SANDVEN, and PETER M. HAUGAN (Nansen Environmental and Remote Sensing Center, Bergen, Norway) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 429-432. refs

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The authors show that systematic characterization of the SAR (synthetic aperture radar)-derived ice edge configurations can provide insight into the dominating air-ice-ocean forces and processes acting along the ice edge. A conceptual 'SAR model' is developed that allows identification of the relationship between SAR-derived ice edge configurations and ice edge processes such as: (1) upwelling; (2) ice-ocean eddies; (3) ice jet and vortex pairs; (4) ice freezing and melting; (5) wave refraction; and (6) ice banding. In combination with realistic ice edge numerical models it is also possible to accurately quantify geophysical variables in the upper ocean and lower atmosphere. I.E.

A92-34949

DETECTION OF MESOSCALE OCEAN CURRENTS FROM GEOSAT ALTIMETER DATA

K. F. WAKKER, M. C. NAEIJE, R. SCHARROO, and B. A. C.

AMBROSIUS (Delft University of Technology, Netherlands) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 465-469. Research supported by SRON, Netherlands Remote Sensing Board, and IBM Nederland. refs

Copyright

A satellite altimeter data processing technique optimized for the detection of mesoscale ocean currents has been developed. The technique allows for the computation of the relative ocean surface flow field at a specified epoch from altimeter measurements, which are irregularly distributed in space and time. The technique has been applied to extract from Geosat altimeter measurements mesoscale ocean current information for the regions of the Agulhas Current, the Southeast Atlantic, and the North Atlantic. Various mesoscale eddies have been identified and some characteristics of the eddies have been determined. I.E.

A92-35025

SIMULATIONS OF SAR IMAGING OF SHIP WAKES, COMPARING DIFFERENT WIND GROWTH RATE MODELS

AGE SKOELV (Norwegian Defence Research Establishment, Kjeller, Norway) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 851-854. refs

Copyright

Seven different wind growth rate models have been implemented in a numerical simulation code able to model the SAR (synthetic aperture radar) imaging of different current-induced ocean phenomena. Radar backscatter values along cross-sections of ship wakes, comparing different growth rate models, are presented. Simulations were performed both in L- and C-band, using the new backscatter model of Holliday et al., (1986). I.E.

N92-12386# Norwegian Defence Research Establishment, Kjeller.

OCEAN/BOTTOM ACOUSTIC INTERACTION WITH ARBITRARY BOTTOM PROFILE

IVAR LIE 5 Jun. 1991 26 p

(ISSN 0802-2437)

(FFI-91/7009; ETN-91-90259) Avail: CASI HC A03/MF A01

A mathematical model for ocean/bottom acoustic interaction using a multidomain spectral technique was previously presented. This model uses a nonlinear variable coefficient set of partial differential equations for acoustic propagation in water, and the conventional equations for linear elasticity with variable coefficients to model the acoustics in the bottom. The mathematical model is now generalized to allow for arbitrary bottom profiles. The study of acoustic propagation with arbitrary bottom profiles is important to study phenomena like e.g., diffraction from a seamount and mode coupling for a sloping bottom. Numerical experiments show that the results of the model agree with those of other related models. ESA

N92-17169# Naval Postgraduate School, Monterey, CA.

AN INVESTIGATION OF COLD OVERFLOW OVER THE ICELAND/FAEROES RIDGE M.S. Thesis

PETER A. TUNNICLIFFE Dec. 1990 107 p

(AD-A243084) Avail: CASI HC A06/MF A02

Hydrographic data were analyzed to determine spatial and temporal variability of the overflow of cold, fresh Arctic water over the Iceland/Faeroes Ridge into the Iceland Basin during both winter and summer. Regions of frequent intermittent overflow were located together with areas that remain relatively unaffected by this process. A time series of near bottom temperatures revealed a possible link between significant overflow events and local wind fields which may result in a seasonal contrast in conditions. Two overflow mechanisms were identified: an intermittent plume-like flow promoted by local wind forcing; and a continuous thin veil of mixed overflow water formed from more significantly sized eddies/filaments located on top of the ridge. Estimates were made as to the probable contribution of both mechanisms to the total

transport of Norwegian Sea water into the North Atlantic Ocean. Dynamic models of overflow were reviewed and, based on hydrographic results, a probable mechanism for overflow was proposed. Sound speed profiles were constructed representing the presence/absence of overflow events and predicted sonar ranges were computed using a range-dependent parabolic equation model. Major effects on acoustic propagation are shown to be confined to regions close to the top of the rise, even during overflow events; however, large reduction in sonar ranges are predicted for areas on top of the ridge, even at low frequencies (100 Hz). Analysis of observations in the area suggest that the acoustic variability in the region can be related to small changes in sea surface temperature and consequently may lead to a prediction of acoustic conditions in the region using AVHRR imagery. GRA

N92-18089# Manchester Univ. (England). Aeronautical Engineering Group.

MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Quarterly Progress Report No. 3

F. A. PAONESSA, D. NICOLAOU, and T. N. STEVENSON 1 Jul. 1990 19 p
(Contract MOD-2052/88/SPACE(F))
(AERO-REPT-9006; ETN-92-90923) Avail: CASI HC A03/MF A01

Progress in experimental and numerical investigations is reported. A towing tank and trolley are in use and a schlieren system is arranged to obtain plan views of the wave system. The instrumentation and computer system will record up to 24 inputs with a 12 bit accuracy. The first finite difference program with a three dimensional rectangular body moving in an enclosed tank was completed. It is possible to use any density distribution. The program was run with a haline/thermocline at mid depth. Some examples of the results obtained when a body moves below a haline are shown. ESA

N92-18234# Manchester Univ. (England). Aeronautical Engineering Group.

MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Quarterly Progress Report No. 4

D. NICOLAOU, F. A. PAONESSA, and T. N. STEVENSON 1 Oct. 1990 41 p
(Contract MOD-2052/88/SPACE(F))
(AERO-REPT-9011; ETN-92-90928) Avail: CASI HC A03/MF A01

Ray theory is used to derive the equations for the wave patterns produced when a body accelerates from rest or moves with constant speed in a stratified fluid which has a pycnocline or thermocline of finite thickness; a region in which there is a peak in the buoyancy frequency. The equations are derived from a dispersion relation based on a tank density profile. All modes of oscillation can be determined. It is shown that for the $n = 0$ mode both oblique and transverse waves occur whereas for the greater than 0 modes the presence of transverse waves depend on the background conditions and on the speed of the body. For the case when a body is started impulsively from rest, the impulsive start waves are also determined. The wave patterns from small amplitude wave theory compare quite well with finite difference calculations of the full Navier-Stokes equations. ESA

N92-18340# Manchester Univ. (England). Aeronautical Engineering Group.

MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Progress Report No. 2

F. A. PAONESSA and D. NICOLAOU 30 Mar. 1990 16 p
(Contract MOD-2052/88/SPACE(F))
(AERO-REPT-9004; ETN-92-90921) Avail: CASI HC A03/MF A01

Progress in experimental and numerical investigations is reported. The construction of the towing tank is at an advanced stage. With regard to the instrumentation, trial programs were written for the analog to digital input boards to receive data from the conductivity probes to establish the maximum frequency of data sampling that can be obtained and also the maximum amount

of data that can be stored on a given run. The interaction between a periodic 'mean current' induced by internal waves and short surface, a mechanism leading to variations in sea surface roughness, was investigated. A method of overcoming the restriction on the free surface movement is described and preliminary results are given. ESA

N92-28365# Naval Postgraduate School, Monterey, CA.
A NUMERICAL STUDY OF TIME-DEPENDENT WIND FORCING OFF THE WEST COAST OF PORTUGAL, 1987-1988 M.S.

Thesis

STEPHEN L. BUSS Jun. 1991 121 p
(AD-A246775; NPS-OC-91-002) Avail: CASI HC A06/MF A02

A process-oriented numerical study of time-dependent wind forcing is conducted using a ten-layer, beta-plane, primitive equation ocean model to provide insight into mesoscale eddy generation and duration off the west coast of Portugal from 1987 to 1988. The wind forcing used was derived from synoptic surface pressure analyses off Lisbon, Portugal. Results obtained show that eddies generated during the coastal upwelling season (generally occurring during the spring and summer) decay during the winter. Only cyclonic eddies form during the 1987 and 1988 upwelling seasons. The eddies are generated through a combination of barotropic and baroclinic instability mechanisms. Since the wind forcing of the five-month-long 1987 upwelling season generates larger and stronger eddies than the wind forcing of the seven-month-long 1988 upwelling season, eddy characteristics appear to be more influenced by the characteristics (e.g., intensity, duration and frequency of occurrence) of the wind forcing than by the total length of the upwelling season. This study affirms the importance of wind stress forcing to the overall surface circulation and eddy generation in the coastal ocean regime off the west coast of Portugal. GRA

N92-29213# Institute of Oceanographic Sciences, Wormley (England).

EVALUATION OF A SOLENT SONIC ANEMOMETER ON RRS CHARLES DARWIN CRUISE 43

M. J. YELLAND, P. K. TAYLOR, K. G. BIRCH, R. W. PASCAL, and A. L. WILLIAMS 1991 52 p Sponsored in part by Ministry of Agriculture, Fisheries and Food and Admiralty Research Lab.
(IOS-288-1991; ETN-92-91348) Sciences, Deacon Lab., Wormley, Godalming, Surrey GU8 5UB, England, HC 16 Sterling pounds

A prototype Solent sonic anemometer was evaluated by comparison with a propeller vane anemometer and a Kaijo-Denki anemometer and by postcruise wind tunnel tests. The Solent sonic anemometer is a newly available instrument. Its low power consumption means that it would be suitable for buoy mounting. Following the trials, changes were made to the production model design. Using the calibration procedures used for production models, the Solent sonic should measure the mean wind to better than the 1.5 specified. The spectra from the prototype showed an increase in level at frequencies above about 2 Hz which is believed to be due to noise. This problem appears to have been overcome in production models by the faster sonic sampling rate. Wind stress values, determined from the observed spectral levels using the dissipation technique, were not significantly different from those determined by the Kaijo-Denki. The use of the asymmetrical head model is recommended to minimize the occurrence of spectral distortion when the relative wind direction is within 20 deg of one of the instrument struts. ESA

N92-31014*# Paris VI Univ. (France). Service d'Aeronomie du CNRS.

BOUNDARY LAYER STRUCTURE OVER THE OCEAN OBSERVED BY LEANDRE 1 DURING A TRAMONTANE EVENT

C. FLAMANT, J. PELON, P. FLAMANT (Ecole Polytechnique, Palaiseau, France), and P. DURAND (Toulouse Univ., France) /In NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 381-383 Jul. 1992
Avail: CASI HC A01/MF A03

51 LIFE SCIENCES (GENERAL)

A new airborne backscatter lidar, has been developed by CNRS (Service d'Aeronomie, (SA) Laboratoire de Meteorologie Dynamique (LMD) and the Institut des Sciences de l'Univers) in the frame of the LEANDRE research program. It has been qualified on board the ARAT in autumn 1989 and spring 1990 and was involved in its first cooperative campaign during PYREX in October and November 1990. During this campaign, lidar observations of the perturbations induced on tropospheric flow and boundary layer structure were performed, and results are presented. A large number of experiments were performed, for synoptic situation description (meteorological radiosoundings, constant level balloons) and local flow analysis (aircrafts, radars, sodars). For the first time in such an experiment, a lidar has been flown on a research aircraft to perform altitude resolved observations of these perturbations, and we will present here results obtained for deflected flow structure. In the presence of a synoptic northerly flow, part of it is deflected to the east by the Pyrenees, and accelerated over the Mediterranean by the mountain surroundings. In this case, a low level wind is generated (the Tramontane) bringing cold and dry air over the Mediterranean Sea. As the sea is still at a warm temperature in November (around 17 degrees), an Internal Marine Boundary Layer rapidly grows over the first tens of kilometers and stabilizes at about 1 km depth, corresponding to an altitude just below the Lifting Condensation Level. The whole Marine Atmospheric Boundary Layer (MABL) is characterized by highly turbulent motions bringing large humid particles from the surface up to its top. The lidar signal due to scattering by these particles is then representative of the turbulent kinetic energy in this layer. Author

51

LIFE SCIENCES (GENERAL)

A92-34193* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

GRAVITY EFFECTS ON REPRODUCTION, DEVELOPMENT, AND AGING

JAIME MIQUEL (Alicante, Universidad, Spain) and KENNETH A. SOUZA (NASA, Ames Research Center, Moffett Field, CA) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 71-97. refs

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The effects of various levels of gravity force (obtained by rotation in clinostats or by centrifugation) and the near-weightlessness condition aboard orbiting spacecraft on the fertilization, embryonic development, maturation, and aging of animals are examined. Results obtained from the American and Soviet spaceborne biology experiments are presented including those on mammals, amphibians, fish, birds, invertebrates, and protozoa. Theoretical issues related to the effect of gravity on various physiological systems are discussed together with the future research goals concerning human life in space. It is noted that life in space (after adaptation to near-weightlessness) might be significantly prolonged due to a reduction in metabolic rate and a concomitant decrease in oxygen radical reactions. I.S.

A92-55688

EXPERIENCES DURING A 14 MONTHS OVERWINTERING WITH RESPECT TO POTENTIAL HUMAN HABITATION ON OTHER PLANETS

MONIKA P. PUSKEPPELEIT (German Working Group on Polar Medicine, Glucksburg, Germany) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 7 p. (IAF PAPER 92-0249) Copyright

Studies conducted during an overwintering experiment with human subjects are reviewed in terms of their potential application to analogous phenomena during the habitation of other planets.

Of particular interest are studies regarding: (1) changes in the immune system; (2) human response to isolation in a remote and extreme environment; (3) the ability to perform tasks in the environment. Changes in cutaneous, systemic, and mucosal immunity are shown to be related to the effects of stress factors on the immune system, and the relationship between exposure to UV radiation and immune response is expected to be important. Aerobic exercise and physical labor are shown to mitigate some of the effects of overwintering, while the uniformity of the environment, lack of seasons, and social deprivation can lead to distortions in perception and unusual social behavior. C.C.S.

N92-13547# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

NEUROLOGICAL, PSYCHIATRIC AND PSYCHOLOGICAL ASPECTS OF AEROSPACE MEDICINE

Sep. 1991 80 p Course held in Pensacola, FL, 18-20 Oct. 1989, in Brussels, Belgium, 25-27 Oct. 1989, and in Ankara, Turkey, 30 Oct. - 1 Nov. 1989 (AGARD-AG-324; ISBN-92-835-0631-6; AD-A244245) Copyright Avail: CASI HC A05/MF A01

An overview of the neurological, psychiatric, and psychological aspects of aerospace medicine is presented. The purpose is to further the knowledge of the flight surgeon and aeromedical examiner in the issues of neuropsychiatry. Aeromedical information is provided for the neuropsychiatric specialist. The unique application of psychiatry, psychology, and neurology to the aviation environment is described. Topics such as motivation to fly, human performance, stress in aviation, and the failing aviator are discussed. Further psychiatric and neurologic disorders found among aviators are presented. The unique aspects of assessment and decision making about flying status among neuropsychiatric cases are presented. The concepts and information currently available in aeromedical neuropsychiatry are summarized.

N92-26977# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Lab. of Genetics and Biotechnology.

THIOCAPSA ROSEOPERSICINA, A BACTERIUM FOR SULFUR-RECYCLING IN MICROBIAL ECOSYSTEMS DESIGNED FOR CELSS AND SPACE PURPOSES

P. JANSEN and M. MERGEAY In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 799-803 Dec. 1991 Sponsored by Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture and ESA/ESTEC Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Thiocapsa roseopersicina, an anoxygenic phototrophic bacterium, is used to oxidize/recycle reduced sulfur compounds and to consume degradation products, which are produced in the Microbial Ecological Life Support System Alternative (MELISSA) model (waste recycling and biomass production model). MELISSA is an early, simplified model of a Controlled Ecological Life Support System (CELSS). The tests, which were performed at laboratory scale in batch processes, investigate the different growth conditions and degradation efficiencies of the microorganism for acids and reduced sulfur compounds. The obtained results show the versatility of T. roseopersicina and its interesting potential for use in space projects. The bacterium is able to grow in the dark, in the light, under microaerophilic and anaerobic conditions, under autotrophy and is able to use sulfide, acetate, lactate, ethanol and urea. The results were found by measuring chemical parameters and by evaluating the optical density (660 nm) of the culture in the medium. ESA

N92-27126*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Inst. of Aerospace Medicine.

LONG-TERM EXPOSURE OF BACTERIAL SPORES TO SPACE G. HORNECK, H. BUECKER, and G. REITZ In NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 3 p 1667-1673 Jan. 1992 Avail: CASI HC A02/MF A04; 1 functional color page

With the NASA mission of the Long Duration Exposure Facility (LDEF), the authors have obtained the opportunity to expose *Bacillus subtilis* spores for nearly six years to the space environment and to analyze their responses after retrieval. The experiment was mounted onto a side tray of LDEF facing space. Data shows that the chances of microorganisms surviving in free space will be greatly increased by adequate shielding against solar ultraviolet light. H.A.

52

AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A92-12125

ANALOGY BETWEEN TRAINING FOR DANCERS AND PROBLEMS OF ADJUSTMENT TO MICROGRAVITY - AN EVALUATION OF THE SUBJECTIVE VERTICAL IN DANCERS
KITSOU DUBOIS (IAF, International Astronautical Congress, 41st, Dresden, Federal Republic of Germany, Oct. 8-12, 1990) *Acta Astronautica* (ISSN 0094-5765), vol. 25, Aug.-Sept. 1991, p. 605-613. refs

(IAF PAPER 90-653) Copyright

Research intended to evaluate the subjective vertical of dancers was carried out with reference to Mittelstaedt's observations on the proportional relationship between space sickness and some astronauts' poor evaluation of the subjective vertical. The qualities of body awareness and specific motricity in dancers imply balance, coordination, muscular performance, and perfect orientation, problems that astronauts also encounter in microgravity. O.G.

A92-15956

EFFECTS OF LONG DURATION SPACEFLIGHT ON HUMAN T LYMPHOCYTE AND MONOCYTE ACTIVITY

SERGE MANIE, IRINA KONSTANTINOVA, JEAN-PHILIPPE BREITMAYER, BERNARD FERRUA (Nice, Universite, France; Institut Mediko-Biologicheskikh Problem, Moscow, USSR), and LAURENCE SCHAFFAR (Nice, Universite; Toulouse III, Universite, France; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1153-1158. refs
(Contract CNES-89-1263)

Copyright

Experiments were performed on blood samples from 5 cosmonauts in order to investigate the effects of long duration spaceflight (26 to 166 days) on immune activity. The experiments were performed on cultured mononuclear cells purified from blood samples collected during the preflight period and 24 h after landing. The production of interleukin 2, which is the major cytokine involved in T lymphocyte proliferation, was found to be enhanced after flight in some individuals, whereas the ability of mitogen-stimulated cells to express interleukin 2 receptor was impaired 24 h after flight for two cosmonauts out of five. Normal interleukin 2 receptor expression was obtained in all cases when lymphocytes were directly activated by a protein kinase C activating phorbol ester. On the other hand, no significant changes were observed in interleukin 1 production by cultured peripheral blood mononuclear cells. Lastly, the distribution of T lymphocyte subsets was examined in peripheral blood sampled 24 h after landing and was found to be within normal values. Author

A92-15959

SPINAL X-RAY SCREENING OF HIGH PERFORMANCE FIGHTER PILOTS

HARALD T. ANDERSEN (Royal Norwegian Air Force, Institute of Aviation Medicine, Oslo, Norway), ANTHONY S. WAGSTAFF (Occupational Health Service Department, Oslo, Norway), and HARALD U. SVERDRUP (Municipal Acute Health Services

Department, Oslo, Norway) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1171-1173. refs

Copyright

Neck pain and neck injury are common complaints among military aviators flying high performance (HPF) aircraft. Since all candidates for military flying training with the Royal Norwegian Air Force have to meet HPF medical standards, medical selection procedures include a radiological examination of the spine. Nine films of the vertebral column are made with emphasis put on cervical structures. Among 232 applicants, 527 deviations from normal conditions were described (anomalies, degenerative changes and deviations of posture) which average 2.27 diagnoses per spine X-rayed. Of the candidates, 80 were considered entirely within normal limits; 20 were rejected due to the roentgen findings; and five candidates were excluded on final evaluation, their radiological diagnoses contributing to the decision. Although most changes are slight, many significant conditions are demonstrated among young healthy individuals. Since the population is highly selected, the figures presented may be minimum numbers in a western industrialized society. Author

A92-16403

THE WEIGHTLESS EXPERIENCE

JOHN F. PADDAY (Kodak, Ltd., Research Div., Harrow, England) *Aviation Medicine Quarterly* (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 59-76.

Copyright

Consideration is given to parabolic flight by a scientist to conduct experiments in short duration microgravity aboard aircraft where weightlessness is achieved for about 20 sec. The preparation, planning, and performance of these parabolic flights are discussed with emphasis placed on the physiological and psychological aspects of the activity. Parabolic flying by the scientist is considered to be a means to acquiring scientific data and technology by enabling him to perform and observe his experiments at first hand. O.G.

A92-16405

NON-INVASIVE DETECTION OF SILENT MYOCARDIAL ISCHEMIA - A BAYESIAN APPROACH

PER ARVA (Civil Aviation Administration, Oslo, Norway), C. MULLER, and O. MULLER (Oslo City Hospital, Norway) *Aviation Medicine Quarterly* (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 81-85. refs

Copyright

The yearly incidence of silent ischemia have been calculated in the Norwegian pilot population by means of clinical history, clinical examination and exercise-ECG. Pilots who had abnormal findings on exercise-ECG were referred for thallium myocardial scintigraphy and radionuclide ventriculography. The risk of coronary artery disease was calculated by using Bayes theorem of conditional probability. It is concluded that noninvasive criteria for silent ischemia are infrequently observed in Norwegian pilots. When an exercise-ECG shows abnormal changes noninvasive tests provide useful diagnostic information. Conditional probability analysis has proved to be helpful in the aeromedical decision making procedure. Author

A92-16406

CARDIOLOGICAL ASPECTS OF PILOT'S FITNESS TO FLY

R. MAIRE, S. IKRAM, and L. KAPPENBERGER (Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland) *Aviation Medicine Quarterly* (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 86-90. refs

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The most common causes of sudden incapacitation leading to accidents in aviation are of cardiovascular nature. Hence, cardiovascular aspects of the medical examination have to be considered carefully when assessing a pilot's fitness to fly. In this brief overview the commonest cardiological problems are considered in respect of their potential for sudden incapacitation.

Some guidelines are suggested to distinguish the more serious of these problems which may justify withholding a pilot's license, from the trivial ones carrying a minor risk. Author

A92-16408

EEG AS SCREENING METHOD IN AEROMEDICAL SELECTION OF AIR CREW

CLAUS CURDT-CHRISTIANSEN Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 95-98. refs Copyright

Results of a survey on EEG as a screening tool in aeromedical aircrew selection are briefly reviewed. Particular attention is given to the relation between EEG findings in 282 pilots and air crashes due to pilot error, and to the relation between incidence of crashes/episodes of unconsciousness and paroxysmal/non-paroxysmal EEG findings. O.G.

A92-16409

RADIATION EXPOSURE OF AIRCREW

K. B. SHAW (National Radiological Protection Board, Didcot, England) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 99-102. refs Copyright

The International Commission on Radiological Protection recommends that cosmic-ray exposure of crew in jet aircraft should be part of occupational exposure. The Commission's recommendations also include lower occupational dose limits and changes in neutron dosimetry. Radiological surveillance of aircrew is considered in the light of these new recommendations. Doses to crew members can be calculated using data on dose rates together with information on flying hours, altitudes, and routes. Individual radiation monitors are unlikely to be required but aircraft could carry an in-flight monitor to provide confidence in the prediction of worker exposure. Author

A92-18547

EVALUATION OF SPONTANEOUS BAROREFLEX RESPONSE AFTER 28 DAYS HEAD DOWN TILT BEDREST

R. L. HUGHSON (Waterloo, University, Canada; Lyon I, Université, France), Y. YAMAMOTO, G. C. BUTLER (Waterloo, University, Canada), A. GUELL (MEDES, Toulouse, France), and C. GHARIB (Lyon I, Université, France) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 6 p. Research supported by CNES and NSERC. refs (Contract DRET-89-237) (IAF PAPER 91-550) Copyright

The purpose of this study was to evaluate the baroreflex response during supine rest and head up tilt (60 deg) before and immediately after a 28 day 6 deg HDT bedrest in 6 healthy adult men (age 30-42 years). The method determined the spontaneous baroreflex by evaluating beat-by-beat RR-interval from an electrocardiograph, and systolic blood pressure (SBP) from the Finapres, noninvasive continuous BP monitor. These observations from relatively simple noninvasive measurements of RR-interval and SBP show several important new findings: (1) the spontaneous baroreflex can be evaluated in human subjects during experiments of orthostatic stress; (2) the baroreflex slope is reduced on going from supine to the head up tilt position; and (3) 28 days of bedrest reduces the slope of the spontaneous baroreflex. Author

A92-34257

THE MORTALITY OF BRITISH AIRWAYS PILOTS, 1966-1989 - A PROPORTIONAL MORTALITY STUDY

DAVID IRVINE and D. M. DAVIES (British Airways, PLC, London, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 276-279. Research supported by Civil Aviation Authority. refs Copyright

Of 446 deaths among serving and retired British Airways pilots between 1966 and 1989, 411 were analyzed using the Proportional Mortality Ratio (PMR) technique. After removal of the predictable excess of aircraft accidents, excesses of cancer (PMR 1.31) and other accidents (1.60) were balanced by deficits in diseases of

the circulatory (0.83) and respiratory (0.49) systems. While lung cancer was close to expectation (1.10), consistent excesses were shown in all analyses for malignant melanoma (6.68), cirrhosis of the liver (2.88), colon cancer (2.30) and brain/CNS cancer (2.68). Consideration of these ratios in relation to pilots' lifestyle and occupation leads to the conclusion that the brain/CNS cancer excess must be studied further. Author

A92-39180

CARDIAC HEMODYNAMICS AND ORTHOSTATIC STRESS - INFLUENCE OF DIFFERENT TYPES OF PHYSICAL TRAINING

F. LOUISY, Y. STOURBE, and C. Y. GUEZENNEC (Centre d'Etudes et de Recherches de Médecine Aérospatiale, Bretigny-sur-Orge, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-156 to S-157. refs

The effects of different types of physical training on the cardiac hemodynamic responses to orthostatic stress were investigated by measuring cardiac parameters in human subjects divided into three groups: endurance runners, weight-lifters, and nonathletes. It was found that, although the response patterns to orthostatic stress (exposures to -20 and -40 mbar in a LBNP chamber) in these subjects differed as a function of the type of sport, training had no significant bearing on the hemodynamic responses to the orthostatic stress induced by LBNP (at least down to -40 mbar); there was no evidence of an altered baroreflex function in the endurance trained men. I.S.

A92-39214

PERSPECTIVES FOR THE APPLICATION OF THE PENAZ'S METHOD FOR A NON-INVASIVE CONTINUOUS BLOOD PRESSURE MEASUREMENT IN SPACE MEDICINE

L. NOVAK, J. PENAZ (Masarik University, Brno, Czechoslovakia), A. R. KOTOVSKAIA, I. F. VIL'-VIL'YAMS, V. I. LUK'IANIUK, and G. F. NIKOLASHIN (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-230, S-231.

The feasibility of using the Penaz (1973) method of continuous noninvasive arterial pressure (AP) measurements for predicting health impairments in humans under gravitational blood redistribution was investigated in subjects exposed to one of the following conditions: (1) +Gz acceleration in a human centrifuge, (2) tilt-table rest, and (3) low body negative pressure (LBNP). The patterns of AP monitoring were obtained according with the Penaz method, using an instrument (Servotonometer) developed for this method. The analysis of data on the dynamics of AP in subjects undergoing gravitational blood redistribution demonstrates that the Penaz method makes it possible to continuously obtain information on the systolic, diastolic, and pulsive APs; it gives an opportunity to assess the effects of cardiac-rhythm disturbances on the hemodynamics; and makes it possible to predict a subject's health condition during gravitational blood redistribution. I.S.

A92-45012

HEART RATE VARIABILITY AS AN INDEX FOR PILOT WORKLOAD

PETER G. A. M. JORNA (National Aerospace Laboratory, Amsterdam, Netherlands) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 746-751. refs

A key factor in prospective progress toward excessive pilot workload strategy development is the establishment of standardized methods for workload assessment and analysis, in conjunction with validated workload-prediction algorithms. Attention is presently given to one such candidate for standardization, the spectral analysis of heart rate variability (HRV), in view of the results of a simulator study that compared the theoretical evaluation of

flight-task difficulty with heart-rate variability. HRV is found to correlate consistently and meaningfully with variations in aviation workloads. O.C.

A92-45021

VIGILANCE OF AIRCREWS DURING LONG-HAUL FLIGHTS

PH. CABON, R. MOLLARD, A. COBLENTZ, J. P. FOUILLOT (Paris V, Université, France), C. STOUFF, and G. MOLINIER (Direction Generale de l'Aviation Civile, Paris, France) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 799-804. Research supported by Direction Generale de l'Aviation Civile and Airbus Industrie. refs

An effort is made to identify the factors that can modify pilot vigilance and performance during long-haul flights, in order to either institute measures for the reinvigoration of pilots or propose rest and nap periods. A data base encompassing such quantitative physiological data as pilot EEGs, EOGs, and EKGs were used to compile a data base for further evaluation. Vigilance, as indicated by the increase in the slow bands of EEG and in blink frequency, shows important variations during the low workload/monotonous activity cruising phase of a long-range flight. O.C.

A92-50162

BLOOD LACTATE DURING LEG EXERCISE IN MICROGRAVITY

P. ZAMPARO, C. CAPELLI, and G. ANTONUTTO (Udine, Università, Italy) (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 61-64. refs

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Venous blood lactate concentration was measured in five male subjects during cycloergometric exercise in microgravity obtained by parabolic flight maneuvers of about 25 s duration. The subject(s) exercised for at least 7 min at each intensity. Three consecutive parabolas with about 3-min intervals were performed at each workload. The day after the flight experiments, the subject underwent the same experimental protocol on the ground and the blood samples were taken at the very same time intervals as on the aircraft. Lactate concentration in flight and control did not show any appreciable difference once the values are plotted as a function of the relative exercise intensities expressed as a percent of the individual maximum O₂ uptake corrected for the moderate hypoxia prevailing inside the aircraft. Author

A92-50292

INJURIES ASSOCIATED WITH THE USE OF EJECTION SEATS IN FINNISH PILOTS

TUOMO VISURI and JUHANI AHO (Central Military Hospital, Helsinki, Finland) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 8, Aug. 1992, p. 727-730. refs

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All ejection seats events for the time period of 1958-1991 in the Finnish Air Force are analyzed focusing on the injuries sustained by the pilots. The aircraft types included BA Hawk, Mig 21-F-13, Mig-21-Bis, Gnat Folland, Vampire Trainer, and MU-3. All major injuries were associated with Soviet aircraft. One BA-Hawk pilot died because of a direct impact against a tree after a low-altitude ejection. Four Hawk pilots were saved during landing phase by a tandem ejection, receiving only minor injuries. O.G.

A92-52395

CHANGES OBSERVED IN LYMPHOCYTE BEHAVIOR DURING GRAVITATIONAL UNLOADING

AUGUSTO COGOLI (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland) ASGSB Bulletin (ISSN 0898-4697), vol. 4, no. 2, July 1991, p. 107-115. Research supported by Eidgenoessische Technische Hochschule Zuerich. refs

(Contract SNSF-3,338-0,86)

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The effect of microgravity has been extensively studied on

human lymphocytes in several space missions. A clear distinction must be made between two kinds of experiments: (1) with cells purified from the peripheral blood of test subjects before flight and then exposed inflight to mitogens and other activators (these are called in vitro experiments), and (2) with lymphocytes from crewmembers of space missions exposed to mitogens prior to and after flight (ex vivo experiments). The first approach can be considered as basic research in cell biology in space; the second contributes to identifying the effects of the stress of spaceflight on the immune response of astronauts. The results from in vitro experiments have clearly shown that lymphocyte activation is nearly totally depressed in microgravity. This activation depression is confirmed by investigations on earth in the fast rotating clinostat. Conversely, activation is increased when lymphocytes are cultured at 10 g in a centrifuge. In microgravity cell adhesion may be reduced, thus partly accounting for the decreased cell activation. The results of the experiments conducted at 10 g are due to a simultaneous activation of T- and B-lymphocytes by concanavalin A. The reduced activation observed in lymphocytes from crewmembers of space missions can be ascribed to both the physical and psychological stress of spaceflight. Author

A92-56703

EXTENDED LY ALPHA EMISSION AROUND QUASARS AT Z OF MORE THAN 3.6

M. N. BREMER, A. C. FABIAN (Cambridge University Institute of Astronomy, United Kingdom), W. L. W. SARGENT (Palomar Observatory, Pasadena, CA), C. C. STEIDEL (California, University, Berkeley), A. BOKSENBURG (Royal Greenwich Observatory, Cambridge, United Kingdom), and R. M. JOHNSTONE (Cambridge University Institute of Astronomy, United Kingdom) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 258, no. 1, Sept. 1, 1992, p. 23P-27P. Research supported by SERC and Royal Society. refs

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We have detected extended Ly alpha emission around two quasars at z of about 3.6, the highest redshift at which such emission has been detected around quasars. An upper limit for extended Ly alpha emission was obtained for a third quasar at z of about 3.8. Our results show that the covering factor of cold gas at radii of 10-20 kpc from these objects is about 1 percent. We discuss the implications of such a low covering factor for theories of galaxy formation. Author

A92-56944

RIB CAGE SHAPE AND MOTION IN MICROGRAVITY

MARC ESTENNE, MASSIMO GORINI, ALAIN VAN MUYLEM, VINCENT NINANE, and MANUEL PAIVA (Erasmus University Hospital, Brussels, Belgium) Journal of Applied Physiology (ISSN 8750-7587), vol. 73, no. 3, Sept. 1992, p. 946-954. Research supported by Ministère de la Politique Scientifique and Don C. Gnocchi Foundation. refs

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The effect of microgravity on the rib-cage shape and motion and the electromyographic (EMG) activity of rib-cage muscles was investigated by measuring the anteroposterior diameters of the upper and the lower rib cage, the transverse diameter of the lower rib cage, the xiphipubic distance, and the EMG parameters of the scalene and parasternal intercostal muscles in five human subjects seated in a Caravelle 6 R aircraft while it flew a 2 Gz trajectory. The results of instrumental measurements taken during the flight indicated that, during brief periods of weightlessness, the rib cage at end expiration is displaced in the cranial direction and adopts a more circular shape; the tidal expansion of the ventral rib cage is reduced, particularly in its upper portion. The phasic inspiratory EMG activity of the scalenes and parasternal intercostals decreases, while the tonic activity increases. I.S.

N92-18972# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

HIGH ALTITUDE AND HIGH ACCELERATION PROTECTION FOR MILITARY AIRCREW

Oct. 1991 264 p In ENGLISH and FRENCH Symposium held in Pensacola, FL, 29-30 Apr. 1991 (AGARD-CP-516; ISBN-92-835-0638-3) Copyright Avail: CASI HC A12/MF A03

These proceedings include the technical evaluation report, the keynote address, and the 28 papers of the symposium. The papers addressed a variety of topics including (1) decompression sickness and ebullism at high altitude; (2) effects of high acceleration in terms of G-induced loss of consciousness (GLOC), positive pressure breathing (PBG), the anti-G straining maneuver (AGSM), and neck injury protection; (3) modeling effects of high acceleration on the cardiovascular system; (4) very high altitude protection; and (5) integrative protection equipment to high altitude, high acceleration, and other harmful stressors.

N92-18978# Royal Aerospace Establishment, Farnborough (England).

PULMONARY EFFECTS OF HIGH-G AND POSITIVE PRESSURE BREATHING

DAVID H. GLAISTER In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 4 p Oct. 1991 Copyright Avail: CASI HC A01/MF A03

Since positive pressure breathing (PPB) can provoke syncope even at low gravity, its use to support the circulation and prevent G-induced loss of consciousness (G-LOC) appears somewhat of a paradox. Furthermore, when right heart pressures are normally only a few mm Hg, an alveolar pressure of 65 mmHg produced by PPB appears alarming, and concern has been expressed as to the advisability of enhancing G protection. The effects of acceleration and pressure breathing on the circulation, particularly within the lungs, are examined, and it is concluded that when one considers pressure differentials across the walls of the major vessels and heart chambers, these concerns are largely unjustified. Author

N92-18984# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France). Div. de Biomechanique. **G-LOC. GZ AND BRAIN HYPOXIA. GZ/S AND INTRACRANIAL HYPERTENSION**

P. QUANDIEU (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), D. GAFFIE (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), PH. LIEBAERT (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), M. BRIANE (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), J. C. SARRON (Direction des Recherches, Etudes et Techniques, Paris, France), A. GUILLAUME (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), D. TRAN (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).), and J. PH. HAYMANN In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 15 p Oct. 1991 Sponsored in part by DRET G9 Copyright Avail: CASI HC A03/MF A03

The tilt of aircraft during a slow steep turn subjects the pilot to an acceleration which is colinear to the longitudinal axis of the body and can reach several times the acceleration of earth gravity. The purpose of this study is to propose a strictly biomechanic explanation of sudden inflight Loss Of Consciousness (LOC), i.e., brain nerve structures subject to Rapid Onset Rate (ROR) +Gz become functionally inefficient, not because of a shortage of oxygen, but because a sudden rise in brain mechanical stresses causes sudden intracranial hypertension. A simple model is proposed to analyze the following parameters: pressure distribution in the Cerebro-Spinal Fluid (CSF); distribution of stresses and deformations throughout the brain; and changes in blood flow pulsed into the skull. Calculations show the influence of a sudden change in flow rate causing collapses and supercritical flows sometimes followed by intravascular shocks. The first results of this modeling study indicate that ROR +Gz acceleration could augment mechanical stresses inside nerve tissues, and therefore result in sudden intracranial hypertension. Author

N92-18991# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Energetique.

CIRCULATORY BIOMECHANICS EFFECTS OF ACCELERATIONS

D. GAFFIE (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), P. QUANDIEU (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), PH. LIEBAERT (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), D. COHEN-ZARDY (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), T. DAUMAS (Office National d'Etudes et de Recherches Aeronautiques, Paris (France).), and A. GUILLAUME (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge, France) In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 15 p Oct. 1991 Original language document was announced in IAA as A91-45645 Sponsored in part by DRET

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A general physical model of blood flow behavior in vessels is proposed, to have a better understanding of mechanisms which cause inflight loss of consciousness (LOC) in fighter pilots. The problem in the situation when heart work and external disturbances induced by aircraft motions are concomitant. Disturbances are both volume and surface changes. Calculations show that under certain conditions blood flow is limited to a change in flow rate. It can then be hypothesized that under the effect of a sudden load, LOC could be caused by a factor other than brain hypoxia resulting from blood pooling in the pilot's lower limbs. Author

N92-23071# Amsterdam Univ. (Netherlands). Dept. of Physiology.

CONTROL OF BLOOD PRESSURE IN HUMANS UNDER MICROGRAVITY

J. M. KAREMAKER (Amsterdam Univ. (Netherlands).), E. M. AKKERMAN (Amsterdam Univ. (Netherlands).), M. VANLEEUEWEN (Amsterdam Univ. (Netherlands).), K. H. WESSELING (Amsterdam Univ. (Netherlands).), J. J. SETTELS (Amsterdam Univ. (Netherlands).), W. WIELING (Academic Medical Center, Amsterdam, Netherlands), and J. H. A. DAMBRINK In Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 125-128 Apr. 1991 Avail: CASI HC A01/MF A03

Collaborative studies in the general fields of gravity related physiology, of which microgravity research is becoming an essential part, are discussed. Studies include some of the following: tilt and volume regulation; the measurement of finger blood pressure by fingerpress on a K-135 parabolic flight; measurement of respiration, cardiovascular (particularly brain perfusion) and metabolic responses to microgravity under different levels of exercise; and the development of a mathematical model for the description of the cardiovascular responses to tilt maneuvers. ESA

N92-28534# Netherlands Aerospace Medical Centre, Soesterberg.

G-TOLERANCE AND SPATIAL DISORIENTATION: CAN SIMULATION HELP US?

J. SMIT (Netherlands Aerospace Medical Centre, Soesterberg.) and ROBERT E. VANPATTEN (Van Patten, Robert E., Bellbrook, OH) In AGARD, Piloted Simulation Effectiveness 7 p Feb. 1992

Copyright Avail: CASI HC A02/MF A03

Pilots of modern fighter aircraft are endangered by high G-forces, loss of situational awareness, and spatial disorientation. In order to prepare aircrew for these factors, ground based training facilities simulating some aspects of the relevant phenomena are used. The human centrifuge has proven to be rather effective in increasing G-tolerance, especially in conditions of high onset rate. Unrealistic simulations caused by the small radius of rotation in centrifuges can generate disturbing vestibular stimulation. During the development of the human centrifuge at the Netherlands Aerospace Medical Center an investigation was undertaken to find methods to suppress these detrimental effects. Smoothing of centrifuge motion and a realistic, computer-generated outside-vision

system proved to be effective measures. Realistic target tracking and a cockpit-like environment are factors which enhance transfer of training. Author

N92-28844# Office National d'Etudes et de Recherches Aérospatiales, Paris (France). Direction de l'Energetique. **STUDY OF THE LOSS OF CONSCIOUSNESS INFLIGHT BY FIGHTER AIRCRAFT PILOTS [ETUDE THEORIQUE DE LA PERTE DE CONNAISSANCE EN VOL DES PILOTES D'AVIONS DE CHASSE]**

DANIEL GAFFIE and P. QUANDIEU (Centre d'Enseignement et de Recherches de Médecine Aéronautique, Paris, France) 15 Nov. 1990 64 p. In FRENCH (Contract DRET-89-1208) (ONERA-RTS-11/3446-EY; ETN-92-91328) Avail: CASI HC A04/MF A01

A model for studying the blood flow in a flexible blood vessel is proposed. From the symptotic analysis of the flow equations, a one dimensional simplified equation is obtained. In this simplified equation, the flow mean velocity, the blood vessel cross section, and the blood vessel wall mean shear stress are considered. A numerical solution is calculated, by means of a finite volume method, which includes a flow decomposition technique. The results show that the rate of the acceleration of the voluminal force induced by the motion of the aircraft is one of the most important parameters concerning the pilot's loss of consciousness. ESA

N92-33908# National Aerospace Medical Centre, Soesterberg (Netherlands). Afdel. Onderzoek en Ontwikkeling. **RADIATION EXPOSURE OF CIVIL AIR CARRIER CREWMEMBERS [STRALINGSBELASTING VAN VLIEGEND PERSONEEL IN DE BURGERLUCHTVAART]** M. SIMONS Oct. 1991 40 p. In DUTCH (NLRGC/B-1-4/91; ETN-92-92054) Avail: CASI HC A03/MF A01

The available knowledge on radiation exposure of civil aircraft crew members is reviewed. The mean additional radiation exposure of Dutch crew operating on intercontinental routes is estimated to be 3 to 6 mSv per annum, which after 20 years means an estimated risk of 2 to 5 in 1000 to die of occupational radiation related cancer, in addition to the normal expectation for the Dutch population that 250 to 300 in 1000 would die of cancer from causes unrelated to occupational radiation exposure. With respect to the regulatory aspects of radiation protection, it is recommended to consider these crew members as a special category. Possible measures for such a category are discussed. It is recommended that a commission be appointed in charge of the development and evaluation of directives for civil aircraft crews. ESA

53

BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A92-11173 **VIGILANCE IN TRANSPORT OPERATIONS - FIELD STUDIES IN AIR TRANSPORT AND RAILWAYS** REGIS MOLLARD, ALEX M. COBLENTZ, and PHILIPPE CABON (Paris V, Université, France) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 2. Santa Monica, CA, Human Factors Society, 1990, p. 1062-1066. Research supported by Direction Generale de l'Aviation Civile and Societe Nationale des Chemins de Fer Français. refs Copyright

The vigilance and performance of operators of aircraft and trains are examined in two field studies dedicated to determining which factors can modify pilot performance. Physiological data such as EEGs and EOGs and data on task observation are collected to evaluate attentiveness and the parameters of

rest-activity cycles. Specific attention is given to the effects of automation on human performance by considering the reduced work schedules and boredom associated with automation. Vigilance is found to vary directly with workload for pilots, and high occurrences of decreased vigilance are identified for pilots during the cruise mode. Decreased vigilance can occur simultaneously for two crewmembers, thereby affecting the alternation of tasks. The train operators are found to experience decreased vigilance even at times of high activity, and a direct relation between sleep duration and rest onset is described. C.C.S.

A92-13015 **STRESS AND ERROR IN AVIATION**

ERIC FARMER, ED. (RAF, Institute of Aviation Medicine, Farnborough, England) Aldershot, England and Brookfield, VT, Avebury Technical, 1991, 170 p. For individual items see A92-13016 to A92-13027.

Copyright

The present conference on stress and error in aviation encompasses issues relating stress with workload, sleep management, aviation safety, testing systems, the effects of trauma, transmeridian travel, and human factors. Specific issues addressed include personality and task characteristics in helicopter pilot stress, a psychophysiological assessment test system, the assessment of pilot and weapon-system operator workloads, the development of a working model of flight-crew underload, the long-term psychological consequences of a major aircraft accident, and trauma-induced cyclothymia. Also addressed are the implications of irregular work and rest in civil air operations, a comparison of fatigue-related accidents across modes of transport, human factors in cabin safety, and the importance of type-II error in aviation safety research. C.C.S.

A92-13019 **THE DEVELOPMENT OF A WORKING MODEL OF FLIGHT CREW UNDERLOAD**

CAROLE D. BRABY, HELEN C. MUIR, and DON HARRIS (Cranfield Institute of Technology, England) IN: Stress and error in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 35-52. Research supported by British Airways, PLC. refs Copyright

The concept of underload and the factors that affect this type of workload are set forth, and a subjective evaluation of flight crews is undertaken to study underload with respect to automation. Operator states/conditions associated with task performance are used to define underload, and the subjective component (such as boredom) is found to be significant. After examining models of underload based on workload and boredom, a study of 250 commercial flight-crew members is described. Although the need to examine the physiological and behavioral components of underload states is apparent, the subjective study indicates that fatigue, boredom, frustration, and distraction dictate the extent of the underload state. The factors increase with sector length and flight-deck automation, and it is concluded that underload and overload should be integrated into a workload model for aircraft crews. C.C.S.

A92-13020 **THE LONG-TERM PSYCHOLOGICAL CONSEQUENCES OF A MAJOR AIRCRAFT ACCIDENT** CLAIRE MARRISON and TRACY HARRIS (Cranfield Institute of Technology, England) IN: Stress and error in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 53-63. refs Copyright

A study is reported in which the psychological distress of the survivors and bereaved was measured five years after a major aircraft accident. The psychological first aid, counseling, and social support received by the victims are related to psychological health. Implications for the management and counseling of disaster victims are discussed. Author

A92-13027

THE IMPORTANCE OF THE TYPE II ERROR IN AVIATION SAFETY RESEARCH

DON HARRIS (Cranfield Institute of Technology, England) IN: Stress and error in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 151-157. refs
Copyright

It is argued that in certain cases the Type II decision error is the error to avoid in research related to aviation safety. This is illustrated with reference to the relative accident rates of two-crew versus three-crew commercial jet aircraft. Further examples in which the Type II error may be of importance are briefly outlined, as are some of the drawbacks associated with the use of the Type II error. Author

A92-13837

HUMAN RESOURCE MANAGEMENT IN AVIATION

ERIC FARMER, ED. (RAF, Institute of Aviation Medicine, Farnborough, England) Aldershot, England and Brookfield, VT, Avebury Technical, 1991, 205 p. For individual items see A92-13838 to A92-13849.
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The present conference on human-resource management in aviation encompasses the fields of selection and training of pilot candidates, the use and effects of incorporating simulation into pilot training, and issues related to the operation of aircraft. Specific issues addressed include a validation study of a pilot-selection process, a system for selecting ab initio pilot candidates, the use of computer-aided testing, psychological testing in aviation, the Defense Mechanism Test, the simulation of obstacle avoidance, and the simulation of cognitive load in a two-man helicopter. Also addressed are a microcomputer flight-decision simulator, the effectiveness of providing a pilot with two sources of information, a no-smoking trial for chartered flights, a flight-training program, and a conceptualization of aviation psychology on the civil flight deck. C.C.S.

A92-13849

A CONCEPTUALIZATION OF AVIATION PSYCHOLOGY ON THE CIVIL FLIGHT DECK

JOHN B. LONG (University College, London, England) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 177-189. refs
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Conceptions for human-factors engineering and human-computer interaction form the basis for a conceptual interpretation of aviation psychology for the commercial transport flight deck. The flight deck and the air crew are considered as an interactive worksystem for aircraft that supports transportation services. The requirements for a conceptualization of the interactive worksystem are set forth with attention given to supporting data and hypotheses from aviation psychology studies. The conceptualization is applied to aviation concerns including the relationship between efficiency and well-being, functionality, and usability. The conceptualization is of a general nature and can be applied to other areas of work and to other worksystems. C.C.S.

A92-38382

PILOT DISORIENTATION AS THE MOST FREQUENT CAUSE OF FATAL, WEATHER-RELATED ACCIDENTS IN UK CIVIL AND GENERAL AVIATION

WILLIAM S. PIKE Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 229-240. refs
Copyright

An overview is presented that concentrates on pilot disorientation as being the most commonly reported cause of fatal weather-related civil aircraft accidents in the UK. During an analysis of UK general and civil aviation weather-related aircraft accidents, it was found that 39 of the 46 fatal accidents reported during the decade 1977-1986 had been at least partly caused by various forms of pilot disorientation in low cloud, fog and/or heavy precipitation. The three factors most commonly involved in major civil aviation accidents are the pilot's visual flight in IFR conditions,

crew navigational error, and a pilot's failure to react correctly to new circumstances resulting from air traffic control instructions or advice. R.E.P.

A92-44926

PILOT ATTITUDES TO COCKPIT AUTOMATION

M. JAMES, A. MCCLUMPHA, R. GREEN, P. WILSON, and A. BELYAVIN (RAF, Institute of Aviation Medicine, Farnborough, England) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 1. Columbus, OH, Ohio State University, 1991, p. 192-197. refs

A study has been conducted to assess the opinions and attitudes of UK commercial pilots to advanced automated aircraft. General findings indicate that pilots believe that flying skills are reduced by automation and that there is an over-reliance on automation. Nevertheless, it is felt that automation on flight decks is advantageous as it reduces crew fatigue, and the majority of pilots enjoy flying automated aircraft. R.E.P.

A92-45065

KNOWLEDGE TRANSFER AND ANTICIPATION IN AIRLINE PILOTING

SYLVIE FIGAROL (Ecole Nationale de l'Aviation Civile, Toulouse, France) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 1074-1079. refs

The methods of cognitive psychology are presently used to study the problem of knowledge transfer when pilots convert to a new aircraft, giving attention to the 'anticipatory' aspect of pilot cognitive activities. Anticipatory competence allows pilots to predict the evolution of a flight and thereby dynamically generate suitable plans of action. A set of hypotheses is formulated for the relationship between anticipation and knowledge transfer, and training tools based on them are derived. O.C.

N92-13548# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).

THE PILOT FLIGHT SURGEON BOND

J. R. GALLE-TESSONNEAU In AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 5 p Sep. 1991

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To become a physician it is necessary to learn medicine and to know diseases, but it is also necessary to have some notions about medicine psychology. To become a flight surgeon, it is necessary to know medicine and aeronautic medicine, but it is also necessary to have some notions about pilot psychology and pilot-flight surgeon relationships. Pilots are not ordinary patients; pilots present some particularities about health, diseases, medicine, and physicians. In the psychological cause, an initiation in theoretical notions and practical attitudes likely to clarify and make understandable phenomena which would otherwise risk appearing unintelligible is presented for the benefit of flight surgeons. As an introduction, three specific and important aspects in the psychology of a pilot are presented: his body, his motivation, and his environment. Author

N92-13550# Institute of Aviation Medicine, Oslo (Norway).

AVIATION PSYCHOLOGY IN THE OPERATIONAL SETTING

GRETE MYHRE In AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 4 p Sep. 1991
Copyright Avail: CASI HC A01/MF A01

Being an aviation psychologist in a small airforce has its advantages, since one has to cover a wide spectrum of tasks, compared to the aviation psychologist in a large airforce who has to specialize in one or two fields. The main tasks of an aviation psychologist are discussed and include the following: (1) teaching flying personnel aviation psychology; (2) acting as a consultant to the aviators on personal matters; (3) performing surveys on the flying personnel's social and working conditions; (4) assisting the flight surgeons on medical boards; (5) acting as a member on aviation accident boards where human factors are involved; and

(6) acting as a consultant in an operational setting. Two case histories are discussed that involve fighter pilots who ejected from their aircraft. Author

N92-13555# Institute of Aviation Medicine, Oslo (Norway).
DOMESTIC PROBLEMS AND AVIATOR FAMILY SUPPORT
 GRETE MYHRE /in AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991
 Copyright Avail: CASI HC A01/MF A01

The usefulness of wives' squadron groups in helping the wives of military pilots deal with their unique family situations is discussed. General psychology in relation to crisis situations is discussed, especially dealing with the feelings of grieving, loss, and mourning following an accident. Case studies are presented. Author

N92-13556# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).
FEAR OF FLYING

J. R. GALLE-TESSONNEAU /in AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 6 p Sep. 1991

Copyright Avail: CASI HC A02/MF A01

When a flyer talks about his apprehension about flying, it becomes a source of concern for his fellow pilots and leaders. Clinical aspects of the fear of flying are reviewed. Clinical forms with predominantly somatic expressions, forms with anxious expression, and neurtoric disorders after an accident are discussed. Predisposing factors, promoting factors, triggering factors and prognosis are covered, as well as treatment. Author

54

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A92-11131
COGNITIVE QUALITY AND SITUATIONAL AWARENESS WITH ADVANCED AIRCRAFT ATTITUDE DISPLAYS

R. M. TAYLOR and S. J. SELCON (RAF, Institute of Aviation Medicine, Farnborough, England) IN: Human Factors Society, Annual Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 1. Santa Monica, CA, Human Factors Society, 1990, p. 26-30. refs

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Highly agile combat aircraft create demanding requirements for the cognitive quality of aircraft attitude information. Evidence is presented on aircrew decision-making performance on simulated attitude recovery tasks requiring situational awareness with different types of attitude representation. Pictorial aircraft 'outside-looking-in' attitude representations appear to require cognitive rotation prior to response selection. A pictorial Command Indicator (CI), with only small attitude deflections, generated relatively low processing demands, without increasing situational awareness. A contact analog Attitude Indicator (AI) representation was superior to relatively less familiar Head-Up Display (HUD) pitch scale, even when switching attention between references. The supremacy of AIs is attributed to the greater accessibility and compatibility of appropriate 'inside-looking-out' cognitive schemata. HUD representations create relatively low understanding of situations, but appropriate schemata may become more accessible with HUD training. Author

A92-11135
DECISION SUPPORT IN THE COCKPIT - PROBABLY A GOOD THING?

STEPHEN J. SELCON (RAF, Institute of Aviation Medicine, Farnborough, England) IN: Human Factors Society, Annual

Meeting, 34th, Orlando, FL, Oct. 8-12, 1990, Proceedings. Vol. 1. Santa Monica, CA, Human Factors Society, 1990, p. 46-50. refs
 Copyright

Use of expert decision support systems in the context of the military fast-jet aircraft is considered with particular attention given to the electronic crewmember or pilot associate concept. The approach presented provides explicit, system-generated probability estimates at the interface to reduce the uncertainty associated with the decision. It was found that the provision of probability values, which clearly distinguished between decision options, reduced decision latencies and increased subjective confidence, without interfering with memory for relevant details of the decision. Probability values with very small absolute differences between options increased the decision times. O.G.

A92-12427
IN-ORBIT EXPERIMENT OF OBJECT CAPTURE TECHNOLOGY

W. PRENDIN, A. TERRIBILE, and D. MADDALENA (Tecnomare S.p.A., Venice, Italy) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. Research supported by EEC, Istituto Mobiliare Italiano, ASI, et al. refs

(IAF PAPER 91-002) Copyright

Results of the definition study of an in-orbit robotic experiment proposed for utilization within the technology demonstration program of the ESA are presented. The experiment focuses on testing the capability of capturing free-flying objects by employing an automatic tracking technique originally developed for underwater applications in the offshore industry. Consideration is given to the possibility of transferring this technology to space applications. R.E.P.

A92-40438
PROBLEMS EXPERIENCED BY MAN WHEN CONSTRUCTING GIANT STRUCTURES IN SPACE

C. A. TIMSIT (Medispace, Paris, France) IN: SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, p. 307-314. refs

Challenges that will be faced by astronauts during construction and servicing of giant structures in space are discussed. The role of the space suit in coping with these challenges is addressed. The possible use of robots as a substitute for humans in some activities is considered. C.D.

A92-45030
PRAGMATIC SIMULATION, BASICS AND TECHNIQUES

JANUSZ M. MORAWSKI (Academy of Physical Education, Gdansk, Poland) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 857-862. Research supported by LOT Polish Airlines. refs

Various considerations lead to the insight that locomotion rhythms (LRs) are important in the realm of human interaction with dynamic objects. The 'pragmatic' simulation technique presented is illustrated by the case of aircraft longitudinal motion; as compared with the classical fourth-order models, the pragmatic approach yields a 20-30 percent reduction in the computational capacity entailed for these problems. The human-oriented model employed is substantially different from a physics-based one. O.C.

A92-45047
KNOWLEDGE TRANSFER AND SUPPORT SYSTEMS IN FIGHTER AIRCRAFT

JEAN Y. GRAU and CLAUDE VALOT (Centre d'Enseignement et de Recherches de Medecine Aeronautique, Bretigny-sur-Orge, France) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 964-969. refs

Pilot conversion from one aircraft to another with different technology is a process in which knowledge-transfer is as critical a factor as knowledge-acquisition. While transfer may for the pilot

in question be positive in terms of 'cognitive cost', it could also be negative for safety and/or efficiency. This apparent conflict in purposes entails a cautious attitude toward the stipulation of inviolable rules concerning transferred knowledge; every context for transplantation must be ergonomically analyzed, in order to improve and more clearly define the learning process. O.C.

N92-12533# Royal Aerospace Establishment, Farnborough (England). Mission Management Aid Project.

INTEGRATING MACHINE INTELLIGENCE INTO THE COCKPIT TO AID THE PILOT

E. J. LOVESEY and R. I. DAVIS /In AGARD, Machine Intelligence for Aerospace Electronic Systems 8 p Sep. 1991
Copyright Avail: CASI HC A02/MF A03

Combat aircraft of the 21st Century will have to be increasingly well-equipped to counter the future threat, which itself will have become far more potent. This spiralling system complexity will result in unacceptably high cockpit workloads unless some form of automation is provided to aid the pilot. United Kingdom industry and government combined to form a joint venture team to develop a Mission Management Aid which will assist the aircrew throughout the mission. Outlined here are some of the problems to be overcome and some suggestions regarding the major functional areas which will constitute the Mission Management Aid. Author

N92-18994# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.

FRENCH EQUIPMENT FOR INTEGRATED PROTECTION OF COMBAT AIRCRAFT CREWS: PRINCIPLES AND TESTS AT HIGH ALTITUDES [L'EQUIPEMENT FRANCAIS DE PROTECTION INTEGREE POUR EQUIPAGES D'AVIONS DE COMBAT MODERNE: PRINCIPES ET ESSAIS EN HAUTE ALTITUDE]

HENRI MAROTTE (Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).), HENRI VIEILLEFOND (Service de Sante des Armees, Paris, France), DAMIEN LEJEUNE (Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).), and JEAN-MICHEL CLERE /In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 11 p Oct. 1991 In FRENCH; ENGLISH summary
Copyright Avail: CASI HC A03/MF A03

Personal flight equipment, manufactured and tested in France, to be used to protect aircraft crews against the risk of loss of pressurization at high altitudes is discussed. Slow decompression tests up to 60,000 feet showed that the altimetric positive pressure schedule was badly adapted for this kind of equipment. Specific schedules for altimetric dilution and positive pressure were established and tested with a series of rapid decompression experiments (in 2 seconds). Some explosive decompression tests were also performed. The homologation was obtained for the maximum altitude of 65,000 feet, maximum duration above 40,000 feet of 2 to 3 minutes, and an aircraft pressurization schedule of 35 kPa. Author

N92-18996# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.

PHYSIOLOGICAL PROTECTION EQUIPMENT FOR COMBAT AIRCRAFT: INTEGRATION OF FUNCTIONS, PRINCIPAL TECHNOLOGIES [PROTECTION PHYSIOLOGIQUE DES EQUIPAGES D'AVIONS DE COMBAT: INTEGRATION DE FONCTIONS, PRINCIPES TECHNOLOGIQUES]

HENRI MAROTTE (Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).), RAYMOND BEAUSSANT (Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).), RICHARD ZAPATA (L'Air Liquide, Sassenage, France), JEAN-MICHEL CLERE (Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).), and DAMIEN LEJEUNE /In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 8 p Oct. 1991 In FRENCH; ENGLISH summary
Copyright Avail: CASI HC A02/MF A03

New generation combat aircraft crews are submitted to many kinds of constraints during flight. New technologies were developed, such as the molecular sieve oxygen concentrator (MSOC) or the

electronic technology for command and/or control of regulation systems. The equipment developed allows a survey of data from the unlimited oxygen supply, with low pressure oxygen regulation systems, to anti-G protection, thanks to the assisted positive pressure breathing (APPB) apparatus. These systems are orderly integrated into the same multiple equipment systems with both respiratory and anti-G functions. New perspectives were developed: altimetric dilution schedules usable with a partial pressure suit; compatibility of the flight equipment with non-integrated functions; and thermal (cold) protection in case of accidental immersion or nonbattle casualty (NBC) protection equipment. Author

N92-18999# Normalair-Garrett Ltd., Yeovil (England). Military Breathing Systems.

ADVANCES IN THE DESIGN OF MILITARY AIRCREW BREATHING SYSTEMS WITH RESPECT TO HIGH ALTITUDE AND HIGH ACCELERATION CONDITIONS

NIGEL P. J. LOVETT /In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 4 p Oct. 1991
Copyright Avail: CASI HC A01/MF A03

It was concluded that for future aircraft systems the combining of an anti-gravity valve and a breathing regulator into one unit provides the most compact and effective system. The advances made by the research establishments in the development of new aircrew garments reduces the need for quick response, electronically controlled valves, thus suggesting that mechanically controlled systems still provide the optimum protection for aircrews under high acceleration conditions. Author

N92-19000# Royal Aerospace Establishment, Farnborough (England).

HIGH ALTITUDE HIGH ACCELERATION AND NBC WARFARE PROTECTIVE SYSTEM FOR ADVANCED FIGHTER AIRCRAFT: DESIGN CONSIDERATIONS

A. J. F. MACMILLAN /In AGARD, High Altitude and High Acceleration Protection for Military Aircrew 7 p Oct. 1991
Copyright Avail: CASI HC A02/MF A03

The physiological, technical and flight safety aspects of the design of an integrated system providing protection against high sustained acceleration, short duration exposure to high altitude and nuclear-biological-chemical (NBC) warfare agents are discussed. The proposed system employs a molecular sieve oxygen concentrator and seat mounted demand regulator and anti-gravity valve together with a source of clean filtered air and an emergency gaseous oxygen supply. The personal equipment assembly comprises counter pressure garments worn external to the NBC protective layer and a man-mounted filter. The filter assembly is used on the ground with a portable ventilator, in the air connected to the breathing gas supply, and post escape as part of a lung powered respirator system. Author

N92-19008# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

HELMET MOUNTED DISPLAYS AND NIGHT VISION GOGGLES

Dec. 1991 121 p In ENGLISH and FRENCH Symposium held in Pensacola, FL, 2 May 1991
(AGARD-CP-517; ISBN-92-835-0645-6; AD-A246925) Copyright Avail: CASI HC A06/MF A02

Papers covered basic and applied issues related to human factors and device integration. Three papers considered the ergonomics of helmet design and the snugness of fit to the head and the integration of new helmet mounted devices with existing equipment. Two papers considered the effects of novel helmet designs on the pilot's ability to control head position and avoid fatigue. Two papers reported in-flight testing of human performance using novel devices. Several papers considered the human factors of visual performance related to such topics as degree of binocular overlap, overall field of view, and the ability to maintain level flight. Other papers considered issues of the nature of information displayed, including data fused from multiple sources and the design of abstract symbologies that present parameters of flight.

N92-19009# IBIS Aerosystems Ltd., Sharnbrook (England).
FIXED WING NIGHT ATTACK EO INTEGRATION AND SENSOR FUSION

LES EVANS *In* AGARD, Helmet Mounted Displays and Night Vision Goggles 5 p Dec. 1991
 Copyright Avail: CASI HC A01/MF A02

Discussed here are some of the aeromedical aspects of the development of fixed wing night attack using electro-optic sensors. Addressed are some of the problems encountered when night vision goggles (NVG's) and Forward Looking Infra-Red (FLIR) equipment were integrated into a complete airborne system. The aeromedical problems encountered when NVG's were used in fast jet aircraft are discussed. It was found that helmet fit had to be tight to ensure that the high helmet rotational forces produced by normal accelerations were contained, and also that when wearing NVG's while pulling 'g', a tumbling sensation could be induced in the pilot by head movements. Author

N92-19013# Royal Aerospace Establishment, Farnborough (England).

THE RAF INSTITUTE OF AVIATION MEDICINE PROPOSED HELMET FITTING/RETENTION SYSTEM

JOHN V. BARSON and ROGER J. CROFT *In* AGARD, Helmet Mounted Displays and Night Vision Goggles 5 p Dec. 1991
 Copyright Avail: CASI HC A01/MF A02

The role of the protective flying helmet has expanded from being a device for protecting the flyer from impact and noise hazards to include mounting platforms for vision enhancement devices as well as target sighting and designation systems. A new helmet fitting and/or retention system is described that has the potential to provide a quick and effective method of rendering a good, safe, and stable helmet fit using a minimum number of helmet sizes. The fitting or retention system also provides a relatively consistent eye position for optical systems and allows rapid donning of a chemical defense respirator. Also, the fitting or retention system can be used for a 'one size fits all' helmet while retaining all the features for personnel who are only flying on specific missions and normally are not issued a flight helmet. The system uses a series of straps and an occipital pusher plate to accommodate head length. The height adjustment is provided by a specifically shaped and contoured pad in the top of the helmet which contacts the head in such a way and over a large area to correctly position the helmet vertically on the head for a wide range of pupil-vertex heights. Author

N92-19019# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France). Div. Vision et Ergonomie.

DOES THE FUTURE LIE IN BINOCULAR HELMET DISPLAY? [L'AVENIR EST-IL AU VISUEL DE CASQUE BINOCULAIRE?]

CORINNE ROUMES, JUSTIN PLANTIER, and JEAN-PIERRE MENU *In* AGARD, Helmet Mounted Displays and Night Vision Goggles 9 p Dec. 1991 *In* FRENCH
 Copyright Avail: CASI HC A02/MF A02

The introduction of a binocular capability in helmet displays can be considered as a rebalancing of visual stimuli between the two eyes, given the specific properties of human vision. The potential advantage of binocular helmets rests with the transposition of visual processing capabilities to the conditions of image generation and reconstruction in the helmet's display. Several problems resulting from this transfer are envisaged: some require experimental investigation, especially determining the tolerance of partial binocularity and to the constraints of the aeronautical environment. In view of these difficulties, the role of binocularity in the display can be envisaged differently in the presentation of real world images through sensors or synthesized input, in the framework of an actual flight or of simulation. Author

N92-19926# Centre d'Etudes et de Recherches Bio-Physiologiques Appliquees a la Marine, Toulon (France). Div. d'Electrophysiologie et Psychophysiologie.

DEVELOPMENT OF AN ELECTROMYOGRAPHY AND ACCELEROMETRY AMBULATORY RECORDING SYSTEM [MISE AU POINT D'UN SYSTEME D'ENREGISTREMENT AMBULATOIRE D'ELECTROMYOGRAPHIE ET D'ACCELEROMETRIE]

J. GRAPPERON, F. LORENZO, F. VIDAL, S. C. P. PITTET, D. BRUSCHERA, D. VILLARD, and A. TROUSSET May 1991
 15 p *In* FRENCH; ENGLISH summary
 (Contract DRET-91-1012-J)
 (CERB-91-07; ETN-92-91083) Avail: CASI HC A03/MF A01

An ambulatory recorder was developed to record, in aircraft, cervical electromyogram and acceleration along two axes measured on the helmet. The work consisted of the adaptation of a pre-existing polygraphic recorder (Medilog 9000). Its working under acceleration was checked, and outputs with those obtained from a laboratory recorder were compared. ESA

N92-25841# Alenia Spazio S.p.A., Turin (Italy).

A COMBINED CABIN/AVIONICS AIR LOOP DESIGN FOR THE SPACE STATION LOGISTIC MODULE

RENATO DAURIA and TIZIANO MALOSTI *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 123-127 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The Mini Pressurized Logistic Module (MPLM) is designed to transport cargo inside the Space Station Freedom. Results obtained from a preliminary design of the heat rejection and temperature control system are reported. Particular evidence is given to the combined cabin/avionics air loop design. This solution allows significant advantages to be gained in terms of mass, cost, control simplification, with respect to the more traditional approach which foresees separated cabin and avionics air loops. ESA

N92-25842# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

ESA STANDARDISATION PROCESS THROUGH THE EXAMPLE OF MANNED SPACECRAFT ATMOSPHERES

C. SOULEZ-LARIVIERE (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).) and J. C. LEPECHON (JCLP Hyperbarie, Paris, France) *In* its 4th European Symposium on Space Environmental Control Systems, Volume 1 p 129-131 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Principles guiding the elaboration of ESA standards (PSS series) in the fields of ECLS (Environment Control and Life Support) and human factors (objectives, ECLS specification tree, applicability, preparation, approval) are detailed. This standardization work is performed within the life support and habitability section of ESTEC. Through the example of manned spacecraft atmospheres, the way standards values are selected and how, as recommended practices, these standards should be used to prepare ECLS subsystem design requirements for supporting the European Manned space Infrastructure is illustrated. ESA

N92-25892# CJB Developments Ltd., Portsmouth (England).

AIR PURIFICATION SYSTEMS FOR SUBMARINES AND THEIR RELEVANCE TO SPACECRAFT

R. A. J. DAMS, C. J. LEPPARD, and T. W. MARTIN *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 493-497 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A submarine's effectiveness is determined in part by its ability to remain submerged for extended periods. If this is to be achieved with a manned vessel, it is essential that the submarine is fitted with the means to maintain a safe and pleasant atmosphere for the crew to breathe. Nuclear powered submarines may remain

isolated from the surface for 90 days or more and their atmosphere control problems are therefore complex. An air purification system must be capable of providing atmosphere constituents which are required by the human physiological process and also of removing harmful contaminants. In practice, this requires that oxygen is replenished and that carbon dioxide, carbon monoxide, hydrogen, Freons, vapors and aerosols are removed. Techniques developed for these purposes in submarines may well have application in a spacecraft. ESA

N92-27007# Nuevas Tecnologias Espaciales S.A., Lissa d'Amunt (Spain).

STUDY ON THE REQUIREMENTS FOR THE INSTALLATION OF A CES AND HABITABILITY CENTRE

A. TOMAS, G. MONSERRAT, and M. PASTOR *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1013-1019 Dec. 1991 Sponsored by ESA and Spanish Space Delegation
Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The need for a center carrying out research activities and technological developments in Closed Ecological Systems (CES) and habitability, as interrelated disciplines when studying life support systems, is pointed out by presenting a list of problems to be solved in space and terrestrial applications. A summary of present developments in the discipline is given and a tentative description for a center is presented, identifying the different functional areas and giving figures of surface and power for these areas. Requirements for the center placement are also suggested. Elements for establishing a schedule for center construction and operations are presented by analyzing the planned space programs and expected terrestrial spin offs. ESA

N92-27010# CJB Developments Ltd., Portsmouth (England).
CRITICAL TECHNOLOGIES: SPACECRAFT HABITABILITY, AN UPDATE

R. A. J. DAMS *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1031-1036 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A study to identify critical technologies relating to spacecraft habitability was performed. Five technologies were identified which were worthy of continuous study because of their magnitude or because it was considered continuous updating of latest terrestrial developments was required. These 'ongoing' technologies were: new methods of food processing and new kinds of space food; space motion sickness, identifying prevention; radiation, acceptable life time limits; provision of artificial gravity; habitation mockup. Latest developments in these technologies, both in space and on Earth are reviewed. ESA

N92-27023# Nelson Space Services Ltd., London (England).
CONCEPT FOR A EUROPEAN SPACE STATION: HABITABILITY, LIFE SUPPORT, AND LABORATORY FACILITIES

R. C. HUTTENBACH (Nelson Space Services Ltd., London (England).), S. D. ORAM (Nelson Space Services Ltd., London (England).), D. A. NIXON (Future Systems Consultants, Los Angeles, CA.), NICK LARTER (Larter (Nick) and Associates, London (England).), and M. COLASSON (Colasson, M., Paris, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1121-1135 Dec. 1991

Avail: CASI HC A03/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A concept for a European space station is described and details of its habitability, life support, safety, power supply, control and laboratory facilities are outlined. There are many opportunities to improve the design of crew accommodation, environmental control, life support systems and laboratory facilities beyond those planned for Space Station Freedom. Using an advanced configuration of the Station, the following are described: approaches to the design

of crew habitability facilities; the outfitting of equipment; environmental control and life support; crew safety and survivability; power supply; data and communications; and the design of laboratory facilities. Driving these proposals is the need to provide a stimulating and sustaining environment that will accommodate crew safety and in a manner that will optimize their efficiency and productivity during all stages of the Station's build up. ESA

N92-27026# Alenia Spazio S.p.A., Turin (Italy).

MOON BASE HABITABILITY ASPECTS

MARIA ANTONIETTA PERINO *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1147-1154 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The main habitat requirements for a Moon base are identified and analyzed. Various issues and technologies related to the local environment in which human beings will operate must be considered so as to choose from among different scenarios and to identify possible design solutions. Moreover, the mission characteristics play an important role in the basic sizing of the habitat, that depend heavily on the crew size and length of stay according to the different phases of the enterprise. Considerations about the influence of human aspects on the habitat design are also drawn, and the requirements to ensure maximum crew safety are outlined. The main habitat features are described, according to a multistep Moon base design approach. The Environment Control and Life Support System (ECLSS) is also regarded as an essential subsystem for any manned space system, and it will require a growing level of self sufficiency with the development of the Moon base's needs. A modular design of the ECLSS is proposed to adapt it for either variable capacities or different evolutionary stages. ESA

55

SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A92-57366

A HISTORY OF THE SCIENTIFIC STUDY OF LIVING ORGANISMS IN SPACE

A. N. MARSHALL (Wolverhampton Polytechnic, United Kingdom) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 11 p. refs
(IAF PAPER ST-92-0022) Copyright

The scientific study of terrestrial organisms in the space environment is surveyed to assess the utility of space biology. Space projects involving biology and microorganisms are reviewed including Soviet and U.S. studies of humans, primates, smaller organisms, and microbes on orbiting satellites and rocket launches. Attention is given to the challenge of generating popular support for such experiments which provide key data on the effects of spaceflight on humans and terrestrial organisms with applications to nonspace science. C.C.S.

COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

A92-26355

PARALLEL COMPUTING - AN INDISPENSABLE TOOL FOR THE NUMERICAL SIMULATION OF TOMORROW [LE CALCUL PARALLELE - UN MOYEN INDISPENSABLE POUR LA SIMULATION NUMERIQUE DE DEMAIN]

MICHEL ENSELME (ONERA, Direction des Moyens d'Informatique, Chatillon, France) (L'Aeronautique et l'Astronautique, no. 148-149, 1991, p. 67-73) ONERA, TP no. 1991-196, 1991, 8 p. In French. refs

(ONERA, TP NO. 1991-196) Copyright

It is emphasized that it is important to study and test the new parallel architectures with more than 100 processors with the aim of evaluating the difficulties and adapting and even restructuring in order to be ready when supercomputers will integrate this architectural design. This is the course that ONERA has been taking over the past ten years in looking at the impact of parallelism on numerical simulation. Consideration is given to examples of results obtained at ONERA on multiprocessor architectures; the Touchstone project; and the creation of an experimentation center for distributed-memory architectures. L.M.

COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms, and specific applications, e.g., CAD/CAM.

A92-19382

REQUIREMENTS

EDWIN M. GRAY (Strathclyde, University, Glasgow, Scotland) and RICHARD H. THAYER (California State University, Sacramento) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 89-122. refs

Copyright

The lack of correct, complete, and understandable software requirements specifications has been identified as the major problem in developing good software within time and cost constraints (frequently called the 'software crisis'). The accepted, best solution for developing a correct, complete, and understandable set of software requirements is to establish a development strategy and to apply a well-defined methodology: a set of procedures, standards, and tools. This paper briefly discusses the state of the practice and the state of the art in methodologies used for software requirements analysis. Examples of each methodology and a set of references to additional information are also provided. Author

A92-19395

ADA

OLIVIER ROUBINE (Verdix Corp., Paris, France) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 365-375. refs

Copyright

This chapter discusses various aspects of the design and use of the Ada language, with emphasis on its suitability in the context of aerospace software. Some of the language characteristics are presented, and the general industrial context of the Ada

61 COMPUTER PROGRAMMING AND SOFTWARE

market-place is defined. Finally, a more detailed outline of the specific language features for real-time applications is given.

Author

A92-19404

AEROSPACE SOFTWARE ENGINEERING IN FRANCE

PATRICK DE BONDELI (Aerospatiale; CR2A, Paris, France) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 525-544. refs

Copyright

This presentation gives an outline on the status in France of four key domains of aerospace software engineering: (1) software development standards, (2) software development methodologies, (3) programming languages, and (4) software development support tools. It then gives the main characteristics of two complementary French military system/software development environments (Entreprise 2 and ITI), which will be used for aerospace system/software engineering and the basic elements of the software engineering plans for some new major aerospace programs, Hermes and Rafale. Author

A92-19405

AEROSPACE SOFTWARE ENGINEERING IN THE UNITED KINGDOM

NICHOLAS JENNINGS (British Aerospace, PLC, Sowerby Research Centre, Bristol, England) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 545-559. refs

Copyright

Certain aspects of software engineering that are of importance to the UK aerospace industry are discussed in the light of the currently considered new UK draft defense standard aimed at increasing the standards for safety-critical software. Particular emphasis is placed on formal methods and their application to aerospace software engineering. The discussion covers requirements analysis, static analysis tools, low-level languages, tools for dynamic testing, code design and implementation, and integrated project support environments. V.L.

A92-19406

AEROSPACE SOFTWARE IN SWEDEN

INGEMAR CARLSSON (Defence Materiel Administration, Stockholm, Sweden) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 561-580. refs

Copyright

Recent developments and current trends in aerospace software systems and processes in Sweden are reviewed. In particular, attention is given to the use of a high-order language system, Pascal D80, in the JAS 39 multirole combat aircraft, the use of the Ada language, computers in space applications, and an industrial approach to the object-oriented development of large-scale systems. The discussion also covers Base/OPEN, a tool development and tool integration framework; the CAX framework concept; and future processing paradigms. V.L.

A92-22185#

CFVIEW - AN ADVANCED INTERACTIVE VISUALIZATION SYSTEM BASED ON OBJECT-ORIENTED APPROACH

D. VUCINIC, M. POTTIEZ, V. SOTIAUX, and CH. HIRSCH (Brussel, Vrije Universiteit, Brussels, Belgium) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 10 p. refs (AIAA PAPER 92-0072) Copyright

CFView, a highly interactive and portable computer-based visualization system, accommodates both 2D and 3D fields on structured and unstructured meshes in multidomain configurations. The data fields can be generated from either the output of numerical visualization codes or from experimental data. CFView is designed on the basis of an object-oriented programming approach, and has been implemented in C++; the software-development platform encompasses a Programmer's Hierarchical Interactive Graphics

Standard library and the InterViews object-oriented toolkit for implementation of a graphical user interface running on top of X Windows. O.C.

A92-22186#

IGG - AN INTERACTIVE 3D SURFACE MODELLING AND GRID GENERATION SYSTEM

C. DENER and CH. HIRSCH (Brussel, Vrije Universiteit, Brussels, Belgium) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 11 p. refs (AIAA PAPER 92-0073) Copyright

The interactive grid generation system (IGG) has been developed as the pre-processor part of a portable CFD package. The system is designed to combine all important elements of pre-processing in a single code for minimizing the manpower in generating 2D/3D multiblock grids for complex configurations. It is also aimed at creating a common object oriented CFD library, which can be reused and extended for different applications. In order to achieve these with efficient use of the latest workstation technology, the object oriented programming (OOP) and C++ are chosen as the conceptual tools. A highly interactive and user-friendly graphical interface is developed for rapid generation of grid boundaries and block grids in a variety of ways. The database developed for the system is used to store and recover the grid generation process at any stage. The object oriented approach, the data model, the graphical user interface and the new interactive techniques are presented together with examples of 3D applications to describe the characteristics of the IGG system. Author

A92-34542#

STRUCTURAL OPTIMIZATION AT AEROSPATIALE AIRCRAFT

CH. BES and J. LOCATELLI (Aerospatiale, Toulouse, France) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 5. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 2619-2624. refs (AIAA PAPER 92-2371) Copyright

The principal features of the first generation of structural optimization software developed at Aerospatiale Aircraft are briefly reviewed. In particular, attention is given to the design optimization model, optimization algorithms, an aircraft sizing and optimization procedure, and global and local identification techniques. Some new features and improvements that are expected to be incorporated into the second generation optimization software tools are outlined. V.L.

A92-45492#

THE DESIGN OF A SYSTEM OF CODES FOR INDUSTRIAL CALCULATIONS OF FLOWS AROUND AIRCRAFT AND OTHER COMPLEX AERODYNAMIC CONFIGURATIONS

J. W. BOERSTOEL, S. P. SPEKREIJSE (National Aerospace Laboratory, Amsterdam, Netherlands), and P. L. VITAGLIANO (Alenia Aeronautica, Pomigliano d'Arco, Italy) IN: AIAA Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 181-191. Research supported by Netherlands Agency for Aerospace Programs. refs (AIAA PAPER 92-2619) Copyright

For industrial calculations of 3D flows around transport aircraft, a system of CFD codes for flow calculations is developed. This system includes codes for aerodynamic geometry modeling in block-decomposition work, multiblock grid generation, Euler and Navier-Stokes flow calculations, and flow visualization. The codes are tuned to each other. Two examples of this tuning are discussed. Analytic representations for geometric shapes of aerodynamic curves and surfaces are presented that may be used for several tasks in CFD work (geometric modeling of block faces and edges, analytic surface representation in grid generators aerodynamic modeling of surface, refacing of aerodynamic configuration surfaces). Multiblock grid generation is simplified by allowing grid lines to be only C0-continuous over block faces. Block-coupling

algorithms for the flow solvers are discussed, that prevent accuracy loss due to the nonsmoothness of the grid over block faces.

Author

A92-47084

MULTIGRID GRID GENERATION IN SCALAR AND PARALLEL ENVIRONMENTS

R. M. SPITALERI (CNR, Istituto per le Applicazioni del Calcolo, Rome, Italy) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 805-815. Research supported by CNR. refs

Copyright

A multigrid algorithm for the numerical generation of boundary-fitted grids is described. The algorithm's experimental performance is evaluated on test problems. Applications in both scalar and parallel computational environments are reported. C.D.

A92-49302

COMPUTER SOFTWARE IN CIVIL AIRCRAFT

J. P. P. POTOCKI DE MONTALK (Airbus Industrie, Blagnac, France) IN: IEEE/AIAA Digital Avionics Systems Conference, 10th, Los Angeles, CA, Oct. 14-17, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 324-330.

Copyright

Airborne software is only one element of an aircraft's systems, and only one element of the aviation software environment. Consequently, it cannot be considered in isolation. Airborne software, is used where its benefits outweigh its advantages, notably to improve human factors, which are involved in most aircraft accidents. The timescales involve extend over many decades, and involve a large number of supplies. Airborne software is produced in accordance with uniquely severe aviation standards. These standards ensure that very great efforts are made to aim at freedom from errors, but freedom from faults is not assumed, and thus fault consequences are assessed and dealt with on a continuing basis. A number of powerful tools have been developed to facilitate software development and compliance with these standards. I.E.

A92-52771

EFFICIENT COMPUTATION OF PARTICLE MOVEMENT IN 3-D DSMC CALCULATIONS ON STRUCTURED BODY-FITTED GRIDS

STEFAN DIETRICH (DLR, Institut fuer Theoretische Stroemungsmechanik, Goettingen, Germany) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 745-752. refs

Copyright

A general purpose program for DSMC calculations around arbitrary body shapes is reported. Structured grids which are characterized by the existence of a transformation into a rectangular grid are used. A former method based on this approach by Abe is shown to produce erroneous results in case of highly oblique grids or singular lines. The new approach presented traces particles in physical space directly by calculating intersection points with the cell surfaces. Without iterative processes it maintains high accuracy, and a speed-up of about 3-5 times compared to Abe's method can be achieved. In addition an unusual vectorization of the movement cycle is presented which gives a further speed-up of a factor five. Author

N92-12451# Federal Ministry for Defence, Bonn (Germany).

TOOL SUPPORTED SOFTWARE DEVELOPMENT EXPERIENCES FROM THE EFA PROJECT

WERNER M. FRAEDRICH /in AGARD, Software for Guidance and Control 7 p Sep. 1991

Copyright Avail: CASI HC A02/MF A03

The European Fighter Aircraft (EFA) Project is a multinational

project. Agreement had to be reached between the partner nations (industry and government) with respect to pertinent data processing support. It is shown that general agreements were worked out by arriving at the lowest common denominator since none of the participating nations were prepared to accept standards established by another partner nation; an attempt to solve this problem is presented. The following topics are addressed: (1) some general information on the EFA Project, including important determinations; (2) the status of the software tool selection and procurement in the EFA Project; and (3) a comparison between required and actual availability of software tools in the EFA Project. Author

N92-12452# Smiths Industries Aerospace and Defence Systems Ltd., Cheltenham (England).

MILITARY AND CIVIL SOFTWARE STANDARDS AND GUIDELINES FOR GUIDANCE AND CONTROL

K. W. WRIGHT *In* AGARD, Software for Guidance and Control 13 p Sep. 1991

Copyright Avail: CASI HC A03/MF A03

The two most widely used standards covering the development of software in the military and civil avionics industries are DOD-STD-2167A and the Radio Technical Commission for Aeronautics (RTCA) DO-178A/European Organization for Civil Aviation Electronics (EUROCAE) ED-12A, respectively. This latter document is currently undergoing extensive update by RTCA Special Committee (SC) 167 and EUROCAE Working Group (WG) 12, with a planned document re-issue date of the end of 1991. A comparison of DOD-STD-2167A with the work currently being undertaken by SC.167/WG.12. Author

N92-12457# GEC Avionics Ltd., Rochester (England). Technology and Systems Research Lab.

FORMAL VERIFICATION OF A REDUNDANCY MANAGEMENT ALGORITHM

JONATHAN DRAPER *In* AGARD, Software for Guidance and Control 6 p Sep. 1991

Copyright Avail: CASI HC A02/MF A03

Work is described on mathematical formal verification of a redundancy management algorithm that was carried out in two stages. The first stage used the specification language Z and verified the specification with hand written rigorous proofs. The second stage used a proof tool to produce formal proofs and specified the system with the language of that proof tool. The system specified was part of a safety critical software section of an avionic system. A section is included that presents the theoretical concepts of formal methods, concentrating on specification and proof. These ideas are illustrated with extracts from the formal specifications. Some of the benefits and problems of using mathematical proof for verification are described in the illustration of the redundancy management example. Author

N92-12461# Electronic System G.m.b.H., Munich (Germany). **PROCESS/OBJECT-ORIENTED ADA SOFTWARE DESIGN FOR AN EXPERIMENTAL HELICOPTER**

K. GRAMBOW *In* AGARD, Software for Guidance and Control 7 p Sep. 1991

Copyright Avail: CASI HC A02/MF A03

Discussed here is the software design method for real-time applications written in Ada. It proves that even time critical systems can be implemented in pure Ada. The design method is based on the Ada tasking model in conjunction with object oriented (OOD) principles. Special purpose graphs, derived from Yourdon/DeMarco data flow diagrams (DFDs), illustrate the method, while Ada program design language (PDL), as a counterpart to the graphs, serves as a basis for the software implementation. No global executive is used to schedule the concurrent threads of execution. Instead, a rendezvous-based interaction of Ada tasks provides the scheduling. This is automatically generated from an Ada compiler. This software design technique is illustrated by the development of the operational flight software for an experimental helicopter. Author

N92-12462# Digital Signal Processing and Control Engineering G.m.b.H., Paderborn (Germany).

CODE GENERATION FOR FAST DSP-BASED REAL-TIME CONTROL

H. HANSELMANN, A. SCHWARTE, and H. HENRICHFREISE *In* AGARD, Software for Guidance and Control 9 p Sep. 1991

Copyright Avail: CASI HC A02/MF A03

Digital single chip signal processors (DSP) are powerful devices to implement closed-loop controllers for highly dynamic mechanisms. However, code production is not that easy, particularly with DSP offering only fixed-point arithmetic. Described here are key issues and a toolset which builds on automatic code generation to complement existing control design tools so as to close the gap between design and implementation or experiment. Author

N92-12465# Dassault (E. M.) Co., Saint Cloud (France). Dassault Electronique.

A PRACTICAL EXPERIENCE OF ADA FOR DEVELOPING EMBEDDED SOFTWARE

CHRISTOPHE GOETHALS and CLAUDE GRANDJEAN *In* AGARD, Software for Guidance and Control 4 p Sep. 1991

Copyright Avail: CASI HC A01/MF A03

The general purpose programming language Ada is discussed. Some important reflections are proposed regarding design methods, real-time aspects, and tools needed, considering the experience with combat aircraft embedded software. Author

N92-12467# Lucas Aerospace Ltd., Birmingham (England).

SOFTWARE METHODOLOGIES FOR SAFETY CRITICAL SYSTEMS

W. C. DOLMAN (Lucas Aerospace Ltd., Birmingham (England)), A. M. ASHDOWN (Lucas Aerospace Ltd., Birmingham (England)), and T. C. MOORES (Ministry of Defence, London, England) *In* AGARD, Software for Guidance and Control 21 p Sep. 1991

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UK MOD (PE) identified Ada as a single preferred high level language for the implementation of defence real-time operational systems. UK MOD (PE) decided to invite proposals for the High Order Language Demonstrator (HOLD) to examine the applicability of Ada to aero gas turbine FADEC. The work carried out to date is described. Author

N92-14631# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept. and ESA Fracture Control Board.

SOFTWARE PRODUCT ASSURANCE REQUIREMENTS FOR ESA SPACE SYSTEMS

Apr. 1991 38 p

(ISSN 0379-4059)

(ESA-PSS-01-21-ISSUE-2; ETN-92-90320) Copyright Avail: CASI HC A03/MF A01

The product assurance requirements for the software developed for ESA space systems where other level 2 Procedures Specifications and Standards (PSS) 01 specifications are applicable are presented. It supports the ESA Software Engineering Standard PSS-05-0 and explains the functions of product assurance, its management and the activities performed by product assurance for each phase of the software lifecycle. ESA

N92-18623# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Design Assurance Dept.

THE NEED FOR ACTIVE SOFTWARE PRODUCT ASSURANCE MANAGEMENT FOR SYSTEMS CRITICAL SOFTWARE

RICHARD BORCZ *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 97-102 Aug. 1991

Copyright Avail: CASI HC A02/MF A03

The quality, reliability and safety impact of space systems software is a major concern. Critical functions of systems are increasingly dependent on software. Should a software failure occur in a critical function there is the potential of harm to human life system loss, long term environmental damage or considerable

financial loss. If high integrity software is needed for systems critical operation it is argued that product assurance management for software must move from a classical passive role to an active mode. Experiences in moving into an active product assurance mode for software are presented. ESA

N92-18647# Agusta Sistemi S.p.A., Tradate (Italy). Systems and Space Business Unit.

RAMREQ: A COMPUTERIZED TOOL FOR THE DEFINITION OF RAM (RELIABILITY, AVAILABILITY, MAINTAINABILITY) REQUIREMENTS OF COMPLEX SYSTEMS

P. CAMERINO /In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 239-247 Aug. 1991 Sponsored by ESA/ESTEC

Copyright Avail: CASI HC A02/MF A03

The software package RAMREQ developed to define the RAM requirements of complex systems (helicopters, aircrafts, and space systems) by the integration of appropriate deductive (top down) and inductive (bottom up) techniques is described. The approach and the mathematical models of RAMREQ, and its preliminary software requirements, were developed under contract for ESA/ESTEC. The validation of the method is carried out in defining the RAM requirements for Hermes. The overall logic flow of the RAMREQ software tool is split into three main processes: the top down RAM apportionment process which makes use of preliminary system information; the bottom up RAM prediction process which makes use of conventional RAM prediction and modeling techniques; and the comparison, assignment, and feedback process which provides the final outputs, and controls the whole model by continuous feedback and cost optimization. These three processes are described in detail. ESA

N92-20590 Electronique Serge Dassault, Saint Cloud (France).

SPACE SOFTWARE IS FIRST OF ALL SOFTWARE [LE LOGICIEL SPATIAL EST D'ABORD DU LOGICIEL]

PHILIPPE LORIER and BRUNO MEHU /In CNES, The Management of Large Software Projects in the Space Industry p 23-32 Jun. 1991 In FRENCH; ENGLISH summary Previously announced in IAA as A91-47752

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The use of software tools and methods in avionics and space applications is discussed. Similarities between the software used in these two domains is pointed out. Experience gained with software carried on the SPOT 2 and 3 satellites and on Helios, is described. Experience gained with calculation software on Mirage F1, Mirage 2000, and Rafale fighters is summarized. Software specifications, software validation tests, and configuration management are discussed in view of the experience gained in both the avionic and space software systems. ESA

N92-20600 European Space Agency. European Space Operations Center, Darmstadt (Germany).

DEVELOPMENT OF A CONFIGURABLE INFRASTRUCTURE FOR THE CONTROL OF A LARGE VARIETY OF SPACECRAFT: THE SCOS

B. MULLET /In CNES, The Management of Large Software Projects in the Space Industry p 155-165 Jun. 1991 Previously announced in IAA as A91-47762

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Aspects specific to the development of infrastructure software systems are outlined. Guidelines and recommendations which have been adopted for the SCOS (Spacecraft Control and Operation System) project or which are deduced from the experience gained in the ongoing course of the project are presented. The SCOS example demonstrated that the initial cost overhead implied by the increased project complexity is largely compensated by the advantage of re-using and maintaining a single large system kernel for 3 or more missions. ESA

N92-20610 Aeritalia S.p.A., Turin (Italy). Space Systems Group. **SOFTWARE MANAGEMENT STRATEGIES AND PRACTICES FOR SPACE SYSTEMS DEVELOPMENT**

LORENZO SARLO /In CNES, The Management of Large Software Projects in the Space Industry p 263-270 Jun. 1991 Previously announced in IAA as A91-47772

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Planning, coordination and control of the design and development of the software systems supporting the onboard and ground operations of a space system are discussed. Software management strategies, policies and practices are reviewed. The strategies act horizontally within the committing industrial organization and vertically down the subcontractor tree. The strategies are implemented through program level policies for software development. The ultimate objectives of the management effort are to assure that the deliverable software meet technical and programmatic requirements. Issues related to the insertion of new technologies as well as the transfer process from the development organization to flight operations are considered. Software management from the start of the system life cycle is discussed. Work breakdown and software industrial structures are discussed. Software management, engineering, and verification organizations are defined. Relationships between the software and other system disciplines are reviewed. Assessment of which standards shall be used is presented. The perspective taken is mainly oriented to the design and development of large software systems for space manned laboratories and related ground centers. Lessons learnt so far on the Columbus Attached Laboratory flight and ground infrastructures program and studies are reported. ESA

N92-20615 Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

SIMULATION AND CONTROL OF LARGE SOFTWARE PROJECTS [SIMULATION ET MAITRISE DES GRANDS PROJETS LOGICIELS]

DOMINIQUE MEYER /In CNES, The Management of Large Software Projects in the Space Industry p 313-323 Jun. 1991 In FRENCH Previously announced in IAA as A91-47777

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The growing complexity of space and aeronautical software systems has created a need for control of the software development process from the inception to the completion stages of the process. Software tools of two main types used in such a total control system are described. One group of tools is made up of formalization tools based on data processing processes such as functional analysis, specification and management. The other tools used are verification and validation tools, based on simulation techniques. Experiences in applying these software tools are described. ESA

N92-20626 Logica Ltd., London (England).

WHY IS SPACE SOFTWARE SPECIAL?

P. NORRIS /In CNES, The Management of Large Software Projects in the Space Industry p 435-441 Jun. 1991 Previously announced in IAA as A91-47788

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Two of the implications of the uniqueness of space software are discussed: software development environments tailored for space software; and research to address the specific requirements of space software. Characteristics of onboard software are discussed including the space environment and constraints on onboard software. A discussion that these suggest that spaceborne software is different from other forms of software is given. ESA

N92-21847# Rolls-Royce Ltd., Derby (England).

THE PROPOSED REVISION TO RTCA DO178A AND ITS INFLUENCE ON SYSTEM DESIGN

C. D. JACK 1 Nov. 1990 7 p

(PNR-90821; ETN-92-90785) Copyright Avail: CASI HC A02/MF A01

The RTCA document DO-178A entitled 'Software considerations in airborne systems and equipment certification' is introduced. Its importance in the avionics field is explained and some of the changes currently proposed and their possible impact on airborne systems and their certification are explained. Particular consideration is given to high-integrity systems, although the proposed changes could have effects on less critical systems.

ESA

N92-24411* National Aerospace Lab., Amsterdam (Netherlands).

DOMAIN MODELING AND GRID GENERATION FOR MULTI-BLOCK STRUCTURED GRIDS WITH APPLICATION TO AERODYNAMIC AND HYDRODYNAMIC CONFIGURATIONS

S. P. SPEKREIJSE (National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)), J. W. BOERSTOEL (National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)), P. L. VITAGLIANO (Alenia Aeronautica, Naples (Italy)), and J. L. KUYVENHOVEN (Fokker B.V., Schiphol-Oost, Netherlands) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 207-229 Apr. 1992 (Contract NIVR-01604-N)

Avail: CASI HC A03/MF A04

About five years ago, a joint development was started of a flow simulation system for engine-airframe integration studies on propeller as well as jet aircraft. The initial system was based on the Euler equations and made operational for industrial aerodynamic design work. The system consists of three major components: a domain modeller, for the graphical interactive subdivision of flow domains into an unstructured collection of blocks; a grid generator, for the graphical interactive computation of structured grids in blocks; and a flow solver, for the computation of flows on multi-block grids. The industrial partners of the collaboration and NLR have demonstrated that the domain modeller, grid generator and flow solver can be applied to simulate Euler flows around complete aircraft, including propulsion system simulation. Extension to Navier-Stokes flows is in progress. Delft Hydraulics has shown that both the domain modeller and grid generator can also be applied successfully for hydrodynamic configurations. An overview is given about the main aspects of both domain modelling and grid generation.

Author

N92-24487* European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Section.

OBJECT ORIENTED HARDWARE SIMULATION OF SPACECRAFT CONTROL ALGORITHMS

A. T. SUND (European Space Research Lab., Noordwijk (Netherlands)), I. HALVORSEN (Norges Tekniske Høyskole, Trondheim.), O. ROEDSETH (Norges Tekniske Høyskole, Trondheim.), B. FOSS (Norwegian Inst. for Air Research, Kjeller.), and B. POLLE (MATRA Espace, Toulouse, France) *In* its Spacecraft Guidance, Navigation and Control Systems p 419-429 Dec. 1991

Copyright Avail: CASI HC A03/MF A06

The development of a complete simulation system, which integrates plant (spacecraft and environment) simulation and digital controller simulation is reported. A modular concept which uses MATRIX integrated with closed loop hardware models implemented in the C++ object oriented language was developed. As an illustrative example of the use of this simulation tool, the reformulation and simulation of the control loop of the SILEX laser telescope FPA (Fine Pointing Assembly), implemented in assembly and C on a high speed Digital Signal Processor (DSP), is prepared. The digital controller is simulated using both object oriented hardware models and real hardware, and the results are compared. Various data formats have been tested. The comparison shows the simulation has high numerical accuracy, and offers good execution time estimates.

ESA

N92-25306* Technische Univ., Delft (Netherlands).

DELFI: DESIGN, DEVELOPMENT, AND APPLICABILITY OF EXPERT SYSTEMS SHELLS Ph.D. Thesis

HINDRIK DESWAANARONS 1991 300 p (ISBN-90-6275-734-0; ETN-92-91295) Copyright Avail: CASI HC A13/MF A03

The two rule based systems Delfi2 and Delfi2+ and the frame based system Delfi3 are addressed. The various concepts of knowledge representation, inference, and inexact reasoning are discussed as introduction. The Delfi project is outlined and design and evolution of the above systems are described. The applicability of both rule and frame based expert systems is discussed. Applications in medical diagnosis and therapy, financial advice, and aircraft maintenance are chosen as illustrative examples. The time aspects of expert systems on a real time environment are studied. Online knowledge based scheduling is extensively discussed.

ESA

N92-25519* Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.

TRANSF3: A 3-D GRID GENERATOR BASED ON TRANSFINITE INTERPOLATION

R. LEHTIMAEKI 19 Dec. 1991 41 p (PB92-151919; SER-B-91-B34; ISBN-951-22-0903-9) Avail: CASI HC A03/MF A01

A 3-D single block algebraic grid generator was developed. The transfinite interpolation method is used. The surface grids on each (or some) of the six block faces are required as input. The method may be used for multi-block grids where the inter-block boundaries have been predetermined. The basic theory of transfinite interpolation is presented. Instructions for running the grid generation program are given. Also, a sample case is presented.

Author

N92-25848* MATRA Marconi Space, Toulouse (France).

COMPUTATION OF THERMAL RADIATION ON SPACECRAFT WITH MOBILE PARTS

P. RENARD, E. AJDARI, and C. PUILLET *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 179-186 Dec. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

For the computation of thermal radiation on spacecraft, a software, THERMICA, based on optimized Monte Carlo ray tracing techniques was developed. The 1.2 version of this software is presently distributed in Europe on VMS and UNIX machines, and contains significant improvements compared to its predecessor CBTS. The method used in THERMICA for the computation of radiative exchange factors and external fluxes, followed by its integration with the other modules for the computation on spacecraft with mobile parts, are presented. Two project applications illustrate the method: GLOBSAT/METOC (a space observatory of Earth environment) and SILEX (a satellite interlink experiment). In the first one the platform is Earth oriented and the solar array points towards the Sun. In the second one the platform is Earth oriented and the mobile part with two degrees of freedom tracks a geostationary satellite. In both cases, accurate modeling of shading effects and of variable radiative exchange factors was considered critical by the project and after the computation this was proven to be the case.

ESA

N92-27903* Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain). Lab. de Guiado.

FUZZY GUIDANCE SYSTEM EVALUATION

J. R. MARTIN, F. SANCHEZ, P. V. CUENCA, L. M. RODRIGUEZ, and J. B. ECICJA *In* AGARD, Air Vehicle Mission Control and Management 15 p Mar. 1992

Copyright Avail: CASI HC A03/MF A03

A study is described that compares the capability of a fuzzy logic controller with a classical controller P+D (proportional plus derivative). The model used for this investigation is the attitude control of a microsatellite launcher, during the first stage of flight. This model has been chosen because it performs on a very

61 COMPUTER PROGRAMMING AND SOFTWARE

unstable plant; the launcher is conceived without stabilization surfaces and only the body is considered as a generator of aerodynamics forces. Movable-nozzle Thrust Vector Control (TVC) will be used as a flight control device. The problem is studied under three degrees of freedom simulation at two levels, software and hardware. The concept formulated in this work is the analysis of the fuzzy rules that perform robust control during the flight. It has been used on perturbations, a wind profile and misalignments in the launcher. The wind model generates a wind velocity vector, which is constant throughout each run. The wind velocity vector is parallel to the surface of the earth. Author

N92-30952# Mentor Graphics (France). **CONCURRENT ENGINEERING [L'INGENIERIE CONCOURANTE]**

M. LEBOULBAR / In CEP Systemes, ILS, CE, CALS? From Design to Operation 12 p 1991
Avail: CASI HC A03/MF A02

The most important aspects concerning the automation of concurrent engineering are discussed. Concurrent engineering consists of a systematic approach during the product and process design phases, which takes into account simultaneously the production, exploitation, and support constraints. The following topics were discussed: the technology trends of the 80's, the design automation problems, the design time reduction, experiences with pilot projects, and the consulting relationships. Customer partnering, technology exchange, continuous process improvement, and product integration were analyzed. Methods of top down design, system design, and design environments are described. ESA

62

COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

A92-23046 **STATUS AND USER CHARACTERIZATION OF PARALLEL MACHINES FOR DIGITAL SIMULATION [BILAN ET CARACTERISATION PAR LES UTILISATEURS DES MACHINES PARALLELES POUR LA SIMULATION NUMERIQUE]**

Q. V. DINH (Dassault Aviation, Saint-Cloud, France), P. LECA (ONERA, Chatillon, France), and P. THOMAS (Dassault Aviation, Saint-Cloud, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), 3rd Quarter, 1991, 1991, p. 45-53. In French. Research supported by DRET and Service Technique des Programmes Aeronautiques. refs
Copyright

The role of digital simulation in weapon system design (e.g., the design of a combat aircraft) is discussed. The limitations of present-day supercomputers are indicated, and the need for a multidisciplinary study permitting the development of new computation methods and better supercomputers is emphasized. A first evaluation of the use of multiprocessors for digital simulation is presented with reference to industrial (Dassault Aviation) and research (ONERA) points of view. L.M.

N92-16645# Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin (Germany). **PARALLEL AND VECTOR ASPECTS OF A MULTIGRID NAVIER-STOKES SOLVER** GUY LONSDALE and ANTON SCHUELLER Jun. 1991 31 p (ISSN 0723-0508) (PB91-232868; GMD-550) Copyright Avail: CASI HC A03/MF A01

The parallel and vector features of modern supercomputers have increased computing power by orders of magnitude. However, such machines require new approaches when developing numerical

algorithms and programs for the solution of partial differential equations. Convergence and efficiency aspects are discussed which affect the development of a multigrid Navier-Stokes solver for computers which support parallelization and vectorization. A general parallelization strategy (together with algorithmic improvements), numerical experiments and results are presented.

Author

63

CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

A92-26368 **FROM CONCEPT TO MODEL: CONCEPTION AND EVALUATION OF AN ARCHITECTURE FOR A DISTRIBUTED SYSTEM WITH SAHARA - SOME REFLECTIONS ON RESULTS OF THE UTILIZATION OF SAHARA IN THE FRAMEWORK OF THE ELECTRONIC COPILOT [DU CONCEPT A LA MAQUETTE: CONCEVOIR ET EVALUER UNE ARCHITECTURE DE SYSTEME DISTRIBUE AVEC SAHARA - QUELQUES REFLEXIONS SUR LES RESULTATS DE L'UTILISATION DE SAHARA DANS LE CADRE DU COPILOTE ELECTRONIQUE]** MICHEL BARAT, PHILIPPE BENHAMOU (ONERA, Direction des Moyens d'Informatique, Chatillon, France), JACQUES FERBER (Paris VI, Universite, France), and PASCAL NORY (Dassault Aviation, Saint-Cloud, France) (Le Genie Logiciel et ses Applications, Meeting, Toulouse, France, Dec. 9-13, 1991) ONERA, TP no. 1991-216, 1991, 15 p. In French. refs (Contract DRET-89-001-31; DRET-89-34347) (ONERA, TP NO. 1991-216)

The SAHARA software engineering tool is described, and its application to the Electronic Copilot program of Dassault Aviation is discussed. The system under study is modeled using the LADA architecture description language, and the aspects of temporality and interruptibility characterizing the projected systems are considered in detail. Some reflections on results obtained with simulations of the Electronic Copilot are presented. L.M.

A92-48910# **EXPERT SYSTEMS FOR THE TROUBLE-SHOOTING AND THE DIAGNOSTICS OF ENGINES** GIOVANNI TORELLA (Accademia Aeronautica, Pozzuoli, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 13 p. refs (AIAA PAPER 92-3327) Copyright

A study was conducted to assess the possibility of developing expert systems for the trouble-shooting and diagnostics of both reciprocating and gas turbine engines. It is shown that the necessary information for constructing knowledge bases can be obtained from overhaul manuals or direct experience accumulated during the engine service life. For diagnostics, suitable knowledge bases can be built using engine simulation codes. Expert systems can be created using both procedural and declarative languages, with emphasis on full interaction with the user. Applications of expert systems for the trouble-shooting and diagnostics of engines are discussed. V.L.

A92-55182# **A GENERAL APPROACH TO OPTIMAL REAL-TIME GUIDANCE OF DYNAMIC SYSTEMS BASED ON NONLINEAR PROGRAMMING** M. PAUS (Stuttgart, Universitaet, Germany) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 297-305. Research sponsored by Dornier GmbH. refs (AIAA PAPER 92-4378) Copyright

A general approach to optimal real-time guidance of dynamic systems, based on a special shooting method and nonlinear programming, is presented and validated with some examples. The main focus lies on the reduction of the computing time as well as the improvements of the convergence behavior and the implicit generation of startup solutions. The described approach can be used for a wide variety of different systems. Its validity will be demonstrated here on the example of medium-range aircraft intercept maneuvers. Author

N92-12517# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
MACHINE INTELLIGENCE FOR AEROSPACE ELECTRONIC SYSTEMS
Sep. 1991 301 p In ENGLISH and FRENCH Symposium held in Lisbon, Portugal, 13-16 May 1991 (AGARD-CP-499; ISBN-92-835-0628-6; AD-A242025) Copyright Avail: CASI HC A14/MF A03

The papers presented at the Avionics Panel Symposium are compiled. The results of efforts applying Machine Intelligence (MI) technology to aerospace electronic applications are discussed. The symposium focused on application research and development to determine the types of MI paradigms which are best suited to the wide variety of aerospace electronic applications.

N92-12544# National Aerospace Lab., Amsterdam (Netherlands).
REASONING WITH UNCERTAIN AND INCOMPLETE INFORMATION IN AEROSPACE APPLICATIONS
J. C. DONKER In AGARD, Machine Intelligence for Aerospace Electronic Systems 16 p Sep. 1991
Copyright Avail: CASI HC A03/MF A03

In many real-life application areas such as aerospace, decisions have to be made based on imperfect knowledge. If decision makers are to be supported by computer systems, it is desirable that this type of knowledge can be represented. Methods have been developed to represent various kinds of imperfections, such as incompleteness, inexactness, or uncertainty. The development of methods to represent and reason with uncertain or incomplete information is studied. The applicability of the Dempster-Shafer Theory is investigated. Parts of the initiation and identification problems in multi-radar tracking are modeled, and the application is described. It is shown that the Dempster-Shafer Theory promises improvements over the Bayesian approach; however, the latter theory is currently more advanced than the former. Author

N92-20601 European Space Agency. European Space Operations Center, Darmstadt (Germany).
THE INTEGRATION AND TEST OF MODERN SPACECRAFT CONTROL SYSTEMS
N. HEAD and M. JONES In CNES, The Management of Large Software Projects in the Space Industry p 167-174 Jun. 1991
Previously announced in IAA as A91-47763
Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

The implementation and testing of modern spacecraft control systems as a major part of overall ground segment preparation efforts are discussed. As spacecraft become more complex and their operations more ambitious, the scope of the control systems required to support them is increasing. Modern spacecraft are characterized by increasingly intensive launch and early orbit phase operations, complex and lengthy checkout and calibration activities and autonomous, frequently isolated, nominal operations. Multiple telemetry data rates and formats are a normal part of a mission as are command modes both with and without the assistance of onboard software. The extent of the differences between these various mission phases and the resulting differences in the operational modes of the ground segment (including the spacecraft control system) are summarized. Difficulties encountered, if the traditional approach to testing a control system is followed, are summarized. ESA

N92-28581# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
INVERSE CONTROL PROBLEMS: MATHEMATICAL PRELIMINARIES, SYSTEM THEORETICAL APPROACHES, AND THEIR APPLICATIONS TO AIRCRAFT DYNAMICS
E. S. L. H. WIRYOHADIATMOJO Oct. 1991 160 p (LR-665; ETN-92-91403) Avail: CASI HC A08/MF A02

The concept of inverse control problems in multivariable systems is to determine the characteristics of unknown inputs when the characteristics of outputs are known a priori or prescribed. An attempt to provide systematically the necessary mathematical models to describe such problems is reported. By adopting the system theoretical approach, system inverses are constructed using transfer function and state space methods to study the behavior of the dynamics of such systems. The unknown inputs are found to be the outputs of these inverses. Additionally necessary and sufficient conditions for a class of reproducible outputs and for system invertibility are derived. ESA

N92-28648# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
QUASI-RECURSIVE DYNAMICS EQUATIONS FOR SPACECRAFT-BASED FLEXIBLE ROBOTIC MANIPULATORS
P. T. L. M. VANWOERKOM 16 Jan. 1990 78 p (Contract NIVR-02506-N)
(NLR-TP-90028-U; ETN-92-91431) Avail: CASI HC A05/MF A01

The development of the dynamics equations of a spacecraft manipulator system with chain topology is described. The spacecraft may be flexible; the attached manipulator consists of an arbitrary number of links, connected by single degree of freedom rotational joints; none, any, or all of the links may be flexible; a rigid or flexible payload can be accommodated as part of the last link. D'Alembert's principle is used as a starting point for the derivation of the dynamics equations. The equations obtained hold for arbitrary geometry and arbitrary mass properties. By expressing the virtual displacement of an elementary mass in recursive form, algebraic complexity of the resulting equations is also reduced. ESA

64

NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

A92-19124
A TWO-STEP GODUNOV-TYPE SCHEME FOR THE EULER EQUATIONS
ANDREA DI MASCIO and BERNARDO FAVINI (Roma I, Università, Rome, Italy) Meccanica (ISSN 0025-6455), vol. 26, no. 2-3, 1991, p. 179-188. refs
Copyright

A second-order Godunov-type scheme for the Euler equations in conservation form is derived. The method is based on the ENO formulation proposed by Hartem et al. The fundamental difference lies in the use of a two-step scheme to compute the time evolution. The scheme is TVD in the linear scalar case, and gives oscillation-free solutions when dealing with nonlinear hyperbolic systems. The admissible time step is twice that of classical Godunov-type schemes. This feature makes it computationally cheaper than one-step schemes, while requiring the same computer storage. Author

A92-27034#
EMBEDDED MESHES OF CONTROLLABLE QUALITY SYNTHESISED FROM ELEMENTARY GEOMETRIC FEATURES
C. M. ALBONE (Defence Research Agency, Aerospace Div., Farnborough, England) AIAA, Aerospace Sciences Meeting and

Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 14 p. refs
(AIAA PAPER 92-0663) Copyright

A method is described for generating surface and field meshes around complex aircraft configurations. The method, which is known by the acronym FAME (Feature-Associated Mesh Embedding), is being developed with the twin objectives of combining a high degree of automation and ease of use with precise control over mesh quality. It is of composite, overlapping type, and it employs many surface-aligned meshes together with a multiply-embedded background mesh. High-quality meshes should be achievable for configurations with closely-coupled components and for those with components in relative motion. Several examples are shown of meshes generated for configurations having geometrically simple components but combined to form shapes that are representative of practical complex aircraft configurations. Author

A92-27737

SOLVING CONSERVATION LAWS WITH PARABOLIC AND CUBIC SPLINES

K. V. D. EMDE (Oesterreichische Akademie der Wissenschaften, Vienna, Austria) Monthly Weather Review (ISSN 0027-0644), vol. 120, March 1992, p. 482-492. refs
(Contract DFG-SFB-233) Copyright

A continuous curvature cubic-spline method for the treatment of the continuity equation is presented. It is shown that this conservative algorithm, which is second order in time and third order in space, has good amplitude and phase properties. In addition, a positive-definite version is formulated by locally breaking the continuous curvature property. A modified second-order Crowley scheme is also presented, which is positive definite. Results from one- and two-dimensional solid-body rotational-flow experiments, as well as from a two-dimensional deformational flow test, are given. The behavior in a one-dimensional divergent flow is illustrated with solutions of the inviscid Burgers equation. The schemes are extended to dimensions higher than one by Strang's operator-splitting technique. Due to this drawback the schemes are restricted to Courant numbers less than or equal to one. Author

A92-37789

WELL-POSEDNESS IN THE GENERALIZED SENSE FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATION

B. C. V. JOHANSSON (Royal Institute of Technology, Stockholm, Sweden) Journal of Scientific Computing (ISSN 0885-7474), vol. 6, no. 2, June 1991, p. 101-127. refs
(Contract STU-88-01599P; N00014-83-K-0422) Copyright

Both the theory of well-posedness in the generalized sense and boundary conditions are obtained for a linearized, time-dependent Navier-Stokes equation for incompressible flow. It is confirmed that the existence of a unique solution for the Laplace-Fourier transformed problem in conjunction with the corresponding energy estimate implies well-posedness in the generalized sense. Using the existence and uniqueness of solutions of the original problem, more general boundary conditions can be obtained than with the classical concept of well-posedness. This is considered to be important for analysis of boundary conditions for open boundaries (inflow and outflow) as it is necessary to prescribe a high-order derivative of some of the dependent variables. Stability against perturbations is shown with lower-order terms which can be omitted when well-posedness in the generalized sense is investigated. O.G.

A92-38401

WORLD CONGRESS ON COMPUTATIONAL MECHANICS, 2ND, UNIVERSITAET STUTTGART, FEDERAL REPUBLIC OF GERMANY, AUG. 27-31, 1990, SELECTED PAPERS

O. C. ZIENKIEWICZ, ED. (Swansea, University College, Wales) Congress sponsored by International Association for Computational Mechanics and Universitaet Stuttgart. International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 34, no.

3, May 15, 1992, 386 p. For individual items see A92-38402 to A92-38411.

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Consideration is given to numerical simulation of unsteady multiphase pipeline flow with virtual mass effect, a Taylor-Galerkin finite element method for non-Newtonian flows, conservative versions of the locally exact consistent upwind scheme of second order, logic for simple Petrov-Galerkin weighting functions, adaptive finite difference methods for liquid membranes, and second-order approximations in structural genesis and shape finding. Attention is also given to shape optimization of 2D bodies by a boundary changing method and thickness changing method, multicriteria optimization of pin-jointed structures with overall stability constraints, supporting design decisions by the PROLOG database, a posteriori error estimation for triangular and tetrahedral quadratic elements using interior residuals, an adaptive finite element procedure for 2D dynamic transient analysis using direct integration, and characteristic, local grid refinement techniques for reservoir flow problems. O.G.

A92-47047

AN ADAPTIVE SOLUTION TO PARABOLIC PROBLEMS DEFINED ON 3D MULTICONNECTED DOMAINS WITH AUTOMATIC APPROXIMATION OF THE BOUNDARIES

L. DE BIASE (Milano, Universita, Milan, Italy), V. PENNATI (ENEL, Centro di Ricerche Idrauliche e Strutturali, Milan, Italy), and G. RATTI (Milano, Universita, Milan, Italy) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 159-170. refs

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An adaptive method for the solution of parabolic problems on 3D general multiconnected domains by generalized finite difference formulas, with boundary approximation by means of polyhedra is proposed. Different approaches to space refinements are studied and implemented. Numerical examples are given. Author

A92-47053

AN UNSTRUCTURED MESH GENERATION ALGORITHM FOR THREE-DIMENSIONAL AERONAUTICAL CONFIGURATIONS

LUCA FORMAGGIA (Alenia Aeronautics, Turin, Italy) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 249-260. refs

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An unstructured 3D mesh generation strategy aimed at solving compressible flows around aeronautical configurations is presented. The proposed algorithm is based on a front advancing technique. Nodes and elements of the mesh are generated at the same time in accordance to a predefined mesh density distribution. It is concluded that unstructured grid-based methodologies are capable of providing a useful tool for complex 3D aerodynamical analysis. O.G.

A92-47075

GEOMETRICAL CONTROL OF THE FIRST COORDINATE SURFACE OFF THE BOUNDARY

C. DOURSAT and A. PERRONNET (Paris VI, Universite, France) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 629-640. refs

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The Winslow-type elliptic grid generation method is studied. It is shown that one-to-one mapping does not exist for grid generation of some bidimensional regions, and that the one-to-one and character can be restored by introducing appropriate control functions. It is demonstrated how the control functions can be used to control the geometry of the mesh near the boundary. Several examples are given. C.D.

A92-47078

PATCH-INDEPENDENT STRUCTURED MULTIBLOCK GRIDS FOR CFD COMPUTATIONS

JOSE M. DE LA VIUDA (Construcciones Aeronauticas, S.A., Division de Proyectos, Getafe, Spain); JEAN DIET (Aerospatiale, Division Engins Tactiques, Chatillon, France), and GILBERT RANOUX (Control Data France, Paris) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 703-715. refs
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The process of generating a patch-independent structured multiblock grid starting from a CAD surface definition is described. The grid topology and parameters are first defined within the available CAD system, and the grid generator and previously extracted data are then used to generate the body-fitted grid. Some examples are shown. C.D.

A92-47081

GENERATION OF EFFICIENT MULTIBLOCK GRIDS FOR NAVIER-STOKES COMPUTATIONS

TORSTEN BERGLIND and PETER ELIASSEN (Aeronautical Research Institute of Sweden, Bromma) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 769-780. refs
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The aim of this work is to develop a general purpose system that converts a previously generated multiblock Euler grid to a multiblock Navier-Stokes grid. The basic concept is first to displace the surface grids at the configuration in the normal direction a distance that corresponds to the thickness of the boundary layer. Grid points in previously generated blocks are adjusted to these new boundaries by transfinite interpolation. New blocks are inserted in the void between each displaced grid surface and the original grid surface. The out-of-surface grid lines will thereby become almost orthogonal to the configuration surface. The use of O-O topology is ideal to resolve the boundary layer, since grid points are added only in the vicinity of the solid walls. An example of generation of a Navier-Stokes grid around the new Swedish fighter aircraft JAS 39 Gripen is demonstrated. Author

A92-47089

THE CONSTRUCTION, APPLICATION AND INTERPRETATION OF THREE-DIMENSIONAL HYBRID MESHES

J. A. SHAW, J. M. GEORGALA, A. J. PEACE, and P. N. CHILDS (Aircraft Research Association, Ltd., Bedford, England) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 887-898. Research supported by Ministry of Defence Procurement Executive. refs
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The hybrid structured-unstructured approach to mesh generation, whereby regions of regularly ordered hexahedral elements are combined with irregularly arranged tetrahedral volumes, offers the potential of attaining a harmonious balance between mesh quality, efficiency and flexibility. In this paper, techniques developed for the generation, use and graphical analysis of such hybrid meshes are discussed. The structured regions of mesh are constructed using the multiblock approach, while the unstructured regions are defined using the Delaunay algorithm. These regions of alternative mesh type are interfaced using an explicitly defined layer of tetrahedral and pentahedral elements. Examples of the application of the hybrid grid approach are shown for both civil and military aircraft. Particular emphasis on the interpretation of hybrid meshes is given to the creation of, and interpolation of data onto, planes through the grid and the visualization of all mesh elements within a given region. Author

A92-49445

THE ITERATIVE SOLUTION OF TAYLOR-GALERKIN AUGMENTED MASS MATRIX EQUATIONS

D. DING, P. TOWNSEND, and M. F. WEBSTER (Swansea, University College, Wales) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 35, no. 2, Aug. 15, 1992, p. 241-253. refs
Copyright

This paper investigates the convergence properties of iterative schemes for the solution of finite element mass matrix equations that arise through the application of a Taylor-Galerkin algorithm to solve instationary Navier-Stokes equations. This is a time-stepping algorithm that involves Galerkin mass matrix equations at fractional stages within each time-step. Plane Poiseuille flow and shear-driven cavity flow are selected as benchmark problems on which to investigate the effects of various choice of scheme and time-step dependency. The iterative convergence of each mass matrix equation for a single fractional stage is studied, both at the element and the system matrix level. The underlying theory is confirmed and it is shown how optimal iterative convergence rates may be achieved for a Jacobi scheme by employing an appropriate acceleration factor. Moreover, this factor is trivial to compute. The consequential effects on the convergence of the time-stepping procedure to reach steady-state are also considered where nonlinear effects are present. Author

A92-54574

OBJECTIVE REPRESENTATION, AND ANALYSIS, OF FORCE LINES OF A VECTOR FIELD TANGENT TO A SKEWED SURFACE

M. LAZAREFF La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 1, 1992, p. 81-84. refs
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The specific problem of numerical integration of the force lines of a vector field, limited to a skewed surface, is solved by a second-order integration in surface coordinates. The fundamental difficulty in obtaining an objective representation in the presence of regions of high convergence or divergence is partly overcome by a semiautomatic method utilizing the elements of a preliminary topological analysis, and guided by the user's experience. A characterization is offered for the accumulation lines by evaluating the local 'striction friction' and the mean striction integral on a bundle of force lines. R.E.P.

N92-24963# Helsinki Univ. of Technology, Espoo (Finland). Lab. for Strength of Materials.

STABILIZED FINITE ELEMENT METHODS FOR THE STOKES PROBLEM

LEOPOLDO P. FRANCA (Helsinki Univ. of Technology, Otaniemi (Finland).), THOMAS J. R. HUGHES (Stanford Univ., CA.), and ROLF STENBERG Jan. 1991 26 p Submitted for publication (ISSN 0783-9375) (PB92-142298; ISBN-951-22-0525-4; REPT-11) Avail: CASI HC A03/MF A01

Physically the Stokes equations model 'slow' flows of incompressible fluids or alternatively isotropic incompressible elastic materials. In Computational Fluid Dynamics, however, the Stokes equations are an important model problem for designing and analyzing finite element algorithms. The reason being, that some of the problems encountered when solving the full Navier-Stokes equations are already present in the more simple Stokes equations. In particular, it gives the right setting for studying the stability problem connected with the choice of finite element spaces for the velocity and the pressure. It is well known that these spaces cannot be chosen independently when the discretization is based on the Galerkin variational form. In the chapter the authors review a recent technique of stabilizing mixed methods. In the approach the standard Galerkin form is modified by the addition of mesh-dependent terms which are weighted residuals of the differential equations. By the technique it is possible to avoid the stability problem connected with the classical mixed methods and hence the convergence can be established for a wide family of simple interpolations. GRA

N92-28635# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

HYPERBOLIC GRID GENERATION WITH BEM SOURCE TERMS

M. H. L. HOUNJET 9 Oct. 1990 14 p Presented at the International Association for Boundary Element Methods, Rome, Italy, 15-19 Oct. 1990

(Contract NIVR-01904-N)

(NLR-TP-90334-U; ETN-92-91448) Avail: CASI HC A03/MF A01

A method for the generation of O type grids about transverse cross sections of transport type aircraft is presented. The method combined a hyperbolic grid generation scheme with source terms obtained with a Boundary Element Method (BEM) in such a way that O type grids around fairly complex shapes with concavities can be generated easily. The component of the method, a boundary element method, a method to generate grids with a boundary element method, and the hyperbolic grid generation scheme are described, and applications are shown. ESA

N92-29604# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

HYPERBOLIC GRID GENERATION CONTROL BY PANEL METHODS

M. H. L. HOUNJET 15 Feb. 1991 17 p Presented at the 3rd International Conference on Numerical Grid Generation in Computational Fluid Dynamics and Related Fields, Barcelona, Spain, 3-7 Jun. 1991

(Contract NIVR-01904-N)

(NLR-TP-91061-U; ETN-92-91453) Avail: CASI HC A03/MF A01

A method for the generation of OH type grids about transport type aircraft is presented. The method combines a hyperbolic grid generation scheme with source terms obtained with a panel method in such a way that OH type grids around fairly complex shapes with concavities can be generated easily. The components of the method, a method to generate grids with a panel method and the hyperbolic grid generation scheme, are described and applications are shown. ESA

66

SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

A92-20345

REAL-TIME MECHANISMS IN A MULTIBASE KNOWLEDGE SYSTEM [MECANISMES TEMPS REEL DANS UN SYSTEME MULTIBASES DE CONNAISSANCES]

F. DESARD, S. BRUNESSAUX, S. BERTUZZI, T. JOUBERT (Matra Defense Espace, Direction Apui Scientifique et Technologique, Velizy-Villacoublay, France), J.-C. LE MENEC, PH. LALANDA, F. CHARPILLET, and J.-P. HATON (INRIA, Vandoeuvre-les-Nancy, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), 2nd Quarter, 1991, p. 61-68. In French. refs (Contract DRET-89-307)

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The operational requirements for advanced decision-aid computer systems which perform under critical real-time constraints are examined. Such decision support systems should coordinate the work of numerous software entities based on expert operational knowledge, which possibly concern distinct specialized domains but which should cooperate to solve the decision-making problem in an understandable and global manner. From a software point of view, such multibase knowledge systems have to be controlled by a centralized supervision software mechanism which provides an optimal interface with the operational decision-maker. As an example of the approach discussed, attention is given to a pilot assistance system for aircraft self-protection against surface-to-air

threats. The architecture of this system (called ATOME-TR) is described. L.M.

A92-56278

REAL-TIME HELICOPTER SIMULATION USING THE BLADE ELEMENT METHOD

L. MEERWIJK and W. BROUWER (National Aerospace Laboratory, Amsterdam, Netherlands) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 18 p. refs

The background of a program initiated by the National Aerospace Laboratory NLR to extend its moving-base research flight simulator facility with real-time helicopter simulation is discussed. The program's objective and the approach to accomplish them are also examined. Software modules which are typical for helicopters have been developed, tested, and finally implemented within the existing simulation program. The level of sophistication of the modules is such that with the resulting helicopter simulation program, research in the field of handling qualities, man-machine interface, etc. should be possible. The modularity of the flight simulation program and the application of a software package called Common-Data Quality Assurance System resulted in the smooth implementation of the modules. The resulting comprehensive flight simulation program, which provides the means for moving-base pilot-in-the-loop simulation, is characterized by a high degree of flexibility and maintainability due to its modular set-up and the use of the data-file structure. C.A.B.

N92-27888# Royal Air Force, London (England). Combat Operations Centre.

INTERDICTION MISSION PLANNING AND CO-ORDINATION DURING THE GULF CONFLICT 17 JANUARY - 27 FEBRUARY 1991

V. A. MEE and P. J. GOODMAN In AGARD, Air Vehicle Mission Control and Management 5 p Mar. 1992

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The Gulf Air War started for Royal Air Force Tornado GR1 aircraft with the delivery of JP 233 weapons from low level at night. After sustaining unacceptable losses at low level, tactics changed to delivery of freefall 1000 lb bombs from medium level, at first by night and then by day. Accuracies, however, improved dramatically with the arrival in theatre of precision guided munitions. Described here is a typical mission covering all aspects from initial tasking by ATO, through mission planning and coordination with intelligence input to deconfliction and mission execution. Missions were flown as co-ordinated packages, Tornado GR1's being supported by F15C fighter escorts with EW support from F4G 'Wild Weasels' and EF111 'Raven' aircraft. Mission planning by the Royal Air Force was manpower intensive and could have been streamlined with the availability of more automated systems. Several lessons were learned from the conflict, which are listed and discussed. Author

N92-32229# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.

PROCEEDINGS OF THE 53RD SYMPOSIUM ON AIR VEHICLE MISSION CONTROL AND MANAGEMENT [LA GESTION ET LE CONTROLE DES MISSIONS DES VEHICULES AERIENS]

DUNCAN E. MCIVER Jul. 1992 14 p Symposium held in Amsterdam, Netherlands, 22-25 Oct. 1991

(AGARD-AR-310; ISBN-92-835-0678-2; CP-504; CP-504S; AD-A255713) Copyright Avail: CASI HC A03/MF A01

This document gives summaries of papers presented at the Guidance and Control Panel 53rd Symposium held from Oct. 22 to Oct. 25, 1991. Topics covered by these papers include: operational mission considerations; situation assessment; route planning; planning techniques; and implementation aspects. H.A.

THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-19924# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace Science.

A LINEARISED RIEMANN SOLVER FOR GODUNOV-TYPE METHODS

Sep. 1991 22 p Presented at the AGCFM Workshop, Surrey, England, Sep. 1991

(CRANFIELD-AERO-9116; ISBN-1-871564-35-2; ETN-92-91054)
Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC 8 sterling pounds

Very simple linearizations for the solution to the Riemann problem for the time-dependent and for the steady-supersonic Euler equations are presented. When used locally in conjunction with Godunov-type methods, computing savings by a factor of about four, relative to the use of exact Riemann solvers, can be achieved. For severe flow regimes, however, the linearization loses accuracy and robustness, and the use of the Riemann solver adaptation procedure is proposed. This retains the accuracy and robustness of the exact Riemann solver and the computational efficiency of the cheap linearized Riemann solver. Reliable and simple switching criteria are presented. Numerical results for one, two, and three-dimensional test problems suggest that the resulting numerical methods are competitive for practical applications in terms of robustness, accuracy, and computational efficiency.

ESA

PHYSICS (GENERAL)

A92-47422

MODEL OF ANOMALOUS TRANSPORT WITH BACKREACTING LOCALIZED PERTURBATIONS

M. A. DUBOIS, P. BEAUFUME, and B. FROMONT (CEA, Centre d'Etudes Nucleaires de Cadarache, St.-Paul-lez-Durance, France; MIT, Cambridge, MA) Nature (ISSN 0028-0836), vol. 358, no. 6382, July 9, 1992, p. 133-136. refs

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Nonlinear elemental processes operating in systems affected by anomalous transport are studied here using a general model comprising localized structures coupled by two sets of variables: the transported quantity and a measure of the influence of each structure on the diffusion of the transported quantity. The evolution of this model using anomalous transport is studied in a turbulent magnetic plasma as an example. It is believed that this model could provide a basis for studying the behavior of a wide range of nonlinear systems. C.D.

A92-47921

SOME DIRECT METHODS IN ELECTROMAGNETISM [QUELQUES METHODES DIRECTES EN ELECTROMAGNETISME]

J. GAY (CEA, Centre d'Etudes Scientifiques et Techniques d'Aquitaine, Le Barp, France) and B. SCHEURER (CEA, Centre d'Etudes de Limeil-Valenton, Villeneuve-St.-Georges, France) CHOCS (ISSN 1157-741X), no. 3, Dec. 1991, p. 45-58. In French. refs

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Two complementary approaches are presented that permit the study of the mathematical and physical aspects of electromagnetism. Methods based on finite-volume elements are

discussed in terms of geometry, finite-element discretization, and the assumption of finite electromagnetic fields. Direct frequency methods and the use of axisymmetric geometries are reviewed with attention given to the use of integral equations, the coupling of these equations, and the coupling of equations with partial derivatives. Computer codes are described for simulating a range of physical conditions by utilizing a combination of finite-volume and direct frequency treatments. The codes are of value in the calculation of electromagnetic fields generated by missiles and aircraft and in applications to control optimization. C.C.S.

N92-23665# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

ULTRASONIC INVESTIGATION OF (3)HE-A VORTICES IN LOW MAGNETIC FIELDS

K. TORIZUKA, J. P. PEKOLA, and A. J. MANNINEN 8 Aug. 1991 60 p Sponsored in part by Suomen Akatemija, Helsinki; and Akad. Nauk SSSR, Moscow (PB92-142256; TTK-F-A691) Avail: CASI HC A04/MF A01

The authors report ultrasonic measurements on rotating (3)He-A at 26.7 bar pressure and at magnetic fields below 12.0 mT. They observed two distinct types of vortices: the attenuation of zero sound by vortices which were created at small fields is higher than the attenuation by vortices created at high fields. The first order transition between the two vortex states was observed at $H(\text{sub } c)$ approximately $H(\text{sub } D)$ (approx. = 3 mT). The low field structure can be identified with type-1 vortices proposed by Fujita et al. and the high field one with that of Seppala and Volovik and initially discovered in nuclear magnetic resonance (NMR) experiments. The structural change may be viewed as a topological transition, because the d-vector distribution is different for the dipole locked vortices in low fields from that for the dipole unlocked vortices in high fields. In addition, a continuous change between coreless vortices and vortices with a well defined core was observed at low enough fields H' much less than $H(\text{sub } c)$. The vortices in (3)He-A can, therefore, be characterized by three magnetic fields: H' , $H(\text{sub } c)$, and $H(\text{sub } c1)$. The last is the catastrophic field at which the dipole locked vortices become unstable. GRA

ACOUSTICS

Includes sound generation, transmission, and attenuation.

A92-12345

ACOUSTIC ISOLATION OF LAYERS [IZOLACJA AKUSTYCZNA POWLOK]

DANIELJUS GUZAS (Wilenski Instytut Inzynierii Budowlanej, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 124-125, 1991, p. 37-51. In Polish. refs

The theoretical basis of the isolation of layers is presented. Some nomenclature issues are discussed, and the difference between flat and curve layers is presented. Examples for thin layers are presented. Discussion is limited to low frequency which makes noise more difficult to overcome. The analysis concerns large-diameter and thin-walled pipes but also can be applied to small rooms with similar sections. The principles of the selection of resonant dampers with calculations are given. They can be used in aircraft cabin design. Author

A92-16138

THEORETICAL STUDY AND PREDICTION OF BVI NOISE INCLUDING CLOSE INTERACTIONS

PIERRE SPIEGEL and GILLES RAHIER (ONERA, Chatillon, France) ONERA, TP no. 1991-174, 1991, 12 p. Research supported by DRET. refs (ONERA, TP NO. 1991-174)

The following study deals with the highly impulsive blade-vortex

interaction (BVI) noise which is generated by helicopter main rotors in descent flight. Two computer codes have been especially designed to predict it at reduced computing costs, starting from given vortices. The aerodynamic code, called MAIR, predicts the unsteady airloads, even for head-on collisions, by using a singularity method and modeling the vortices as cloud vortices with viscous cores. The acoustic code, called PARIS, computes the resulting radiated loading noise and is based on the Ffowcs Williams and Hawkings equation. These two codes are ready to perform noise prediction in the flight cases but the vortex prediction required for input data still needs to be improved. While waiting for better wake data, the two codes have been used for a theoretical parametric study of arbitrary single blade-vortex interactions. This study gives a physical insight of the phenomenon and its predicted tendencies could help designing quieter blades. Author

A92-26353**COMBAT AIRCRAFT JET ENGINE NOISE STUDIES [ETUDES SUR LE BRUIT DES TURBOREACTEURS APPLICABLES AUX AVIONS DE COMBAT]**

S. LEWY, G. FOURNIER (ONERA, Chatillon, France), and M. PIANKO (Icare, Massy, France) (NATO, AGARD, Symposium on Combat Aircraft Noise, 78th, Bonn, Federal Republic of Germany, Oct. 23-25, 1991) ONERA, TP no. 1991-192, 1991, 18 p. In French. refs
(ONERA, TP NO. 1991-192)

Methods of noise prediction and attenuation, based on results obtained in civil applications are presented. Input data for directivity and radiation forecasts are given by measurements of vane and blade pressure fluctuations, and by modal analysis of the spinning waves propagating in the inlet duct. Attention is given to sound generation mechanisms for subsonic and supersonic single jets and bypass jets. Prediction methods, based on Lighthill's equation (tensor due to the turbulence), are discussed, and the various means of jet noise reduction are reviewed. The CEPRA 19 anechoic wind tunnel, which is primarily designed for studying the jet noise radiated in the far field with flight effects is described. R.E.P.

A92-26363**EXPERIMENTAL STUDY OF THE EFFECTS OF ATMOSPHERIC TURBULENCE ON SOUND PROPAGATION OVER THE GROUND**

S. LEWY and S. CANARD-CARUANA (ONERA, Chatillon, France) (Inter Noise 91, Sydney, Australia, Dec. 2-4, 1991) ONERA, TP no. 1991-211, 1991, 5 p. Research supported by DRET. refs
(ONERA, TP NO. 1991-211)

Studies on long range sound propagation over the ground were initiated at ONERA several years ago, with the final scope of detecting military helicopters and artillery batteries. They can also lead to some applications on lateral attenuation of aircraft noise. Two basic series of tests over about 1 km, using a pulsed electroacoustic source, were performed. The effects of atmospheric turbulence are discussed. Author

A92-39042**INTER-NOISE 90; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NOISE CONTROL ENGINEERING, GÖTEBORG, SWEDEN, AUG. 13-15, 1990. VOLS. 1 & 2**

HANS G. JONASSON, ED. (Swedish National Testing Institute, Borås, Sweden) Conference sponsored by International Institute of Noise Control Engineering, Chalmers University of Technology, STU, et al. Poughkeepsie, NY, Noise Control Foundation, 1990, p. Vol. 1, 738 p.; vol. 2, 762 p. For individual items see A92-39043 to A92-39112.
(ISBN 91-7848-224-0) Copyright

The present conference on noise-control engineering encompasses building acoustics issues such as sound absorption and scattering and sound-intensity applications, environmental noise from wind turbines and aircraft, duct acoustics, noise labeling, sound-power measurements, and issues related to sound propagation of environmental noise. Specific issues addressed include modal and holographic analyses of window sound insulation, poles and zeros in reverberant sound-field transfer

functions, sound absorption by porous flexible materials, noise control and propagation in wind turbines, and measurements of meteorological effects on sound propagation near the ground. Also addressed are airport noise contours, an advanced method for single-event aircraft-noise analysis, the determination of aircraft noise levels while the engine is running on the ground, aeroacoustic wind-tunnel tests on full-scale propellers with unsymmetrical blade spacing, and the measurement of the scattering matrix of acoustical two-port sources. C.C.S.

A92-39060**ADVANCED METHOD FOR SINGLE EVENT AIRCRAFT NOISE ANALYSIS**

K. H. LIASJO, H. OLSEN, and I. L. N. GRANOIEN (Foundation for Scientific and Industrial Research, Trondheim, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 447-450. refs
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A digital recording technique is described that permits the calculation of noise-source parameters from single aircraft noise events. Simulations of flyovers are employed to adjust analog sound recordings to describe aircraft noise as a function of slant distance and aircraft engine operation. Measured data are described which demonstrate the effective treatment of parameters such as source directivity, spectral variation, and distance-dependent attenuation. C.C.S.

A92-39085**COUPLED PROPELLER CONTRIBUTIONS TO AIRCRAFT NOISE AND VIBRATION**

URBAN EMBORG (Saab-Scania, AB, Linköping, Sweden) and WILLIAM G. HALVORSEN (Ingemansson Anatrol, AB, Askim, Sweden) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 821-824. refs
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In-flight sound and vibration data from a twin-engine aircraft are studied by means of signal processing to assess the contributions of each propeller and analyze the coupling of the sound fields. Cross-spectrum averaging is employed for separating the closely spaced pure tones generated by the two propellers on a commuter aircraft. The separated operating deflection shapes (ODSs) are measured with 50 accelerometers mounted in the fuselage in the plane of the propellers. Combined ODSs are computed for five different synchrophase angles of -40 to 40 deg, and increases in fuselage structural damping are found to reduce the forced-response contributions of modes close to the excitation frequency. When the independent contributions of the propellers are about equal significant variation is noted in combined level with synchrophase angle. C.C.S.

A92-39086**EVALUATION OF SOUND TRANSMISSION INTO AIRCRAFT FUSELAGES BY A RECIPROCITY TECHNIQUE**

J. M. MASON and F. J. FAHY (Southampton, University, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 825-828. Research supported by Department of Trade and Industry of England.

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This paper discusses the continuing development of a new experimental technique for characterizing sound transmission into structures using reciprocity principles. Transfer function measurements are made from a point source inside a fuselage model to the transduced vibration on its outside surface. It is demonstrated, for a localized excitation of a fuselage model, that the reciprocity relationship employed is valid, and that sound transmission is accurately represented. Further, it is shown that

the resulting internal sound pressure level inside four cylinder configurations is not just sensitive to the structural parameters, but also to the form of the acoustic excitation field. Author

A92-39109

ACTIVE CONTROL OF PULSED FLOW FOR LOW FREQUENCY NOISES ATTENUATION

J. LAUMONIER, J. TARTARIN, and J. L. PEUBE (Poitiers, Universite, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1293-1296. refs
Copyright

An active 'antipulsatory' device comprising a low-resolution activator and controls is described and demonstrated for the attenuation of noises emitted by industrial airflows. The development of an automated version of the device is considered with attention given to the applicable frequency range and its ability to attenuate the fundamental and first harmonics of airflow noises. The conditions of optimal attenuation are described, and it is shown that an automated system based on these principles can be effective in the active treatment of industrial noise and/or vibration. C.C.S.

A92-44197

ACOUSTIC TRANSMISSION THROUGH A 2-D ORTHOTROPIC MULTI-LAYERED INFINITE CYLINDRICAL SHELL

A. BLAISE and C. LESUEUR (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) Journal of Sound and Vibration (ISSN 0022-460X), vol. 155, no. 1, May 22, 1992, p. 95-109. Research supported by CNES. refs
Copyright

An investigation is presented of the transmission loss of two-dimensional orthotropic multilayered infinite cylindrical shells. Equations of motion are established by using a variational displacement formulation; these equations remain unchanged in form whatever the number of layers. Numerical results are presented illustrating the influence of acoustic and structural parameters on the transmission loss. Author

A92-48594

STUDY OF NOISE GENERATED BY THE IMPINGEMENT OF A HOT SUPERSONIC JET ON AN OBSTACLE [ETUDE DU BRUIT ENGENDRE PAR L'IMPACT D'UN JET SUPERSONIQUE CHAUD SUR UN OBSTACLE]

B. JACQUET and D. GELY (ONERA, Chatillon, France) (Congres Francais d'Acoustique, 2nd, Arcachon, France, Apr. 14-16, 1992) ONERA, TP no. 1992-33, 1992, 5 p. In French. Research supported by CNES. (ONERA, TP NO. 1992-33)

Experimental work on supersonic hot jet impingement noise has been performed in an anechoic wind tunnel. Far field noise directivity measurements were done for a supersonic jet impingement on an axisymmetric obstacle. Source localizations with focused microphone arrays were realized simultaneously. Introduction of a board in a jet increases the sound pressure level upstream of the board. The localizations with focused microphone arrays show that the predominant sources of noise are located near the impingement region. However, this appearance of sound sources does not amount to a large increase of the total sound power level. Author

A92-48595

CHARACTERIZATION OF SUBCRITICAL AND SUPERCRITICAL JETS BY AN ACOUSTIC IMAGERY METHOD [CARACTERISATION DE JETS SUBCRITIQUES ET SUPERCRITIQUES PAR UNE METHODE D'IMAGERIE ACOUSTIQUE]

C. DINE, D. GELY, and G. ELIAS (ONERA, Chatillon, France) (Congres Francais d'Acoustique, 2nd, Arcachon, France, Apr. 14-16, 1992) ONERA, TP no. 1992-34, 1992, 5 p. In French. refs
(ONERA, TP NO. 1992-34)

An experimental investigation conducted to characterize the acoustic field of subcritical and supersonic jets was performed by ONERA at CEPr in the CEPRA 19 anechoic wind tunnel. The main interest of this study is the use of focused antenna processing to localize acoustic sources. From the acoustic pictures obtained, several results were found, especially a dimensionless relation between jet acoustic source position and frequency available for all the speeds tested. Author

A92-48596

CALCULATION OF NOISE GENERATED IN FLOWS ON THE BASIS OF AN AERODYNAMIC/ACOUSTIC DECOMPOSITION [CALCUL DU BRUIT PRODUIT DANS LES ECOULEMENTS A PARTIR D'UNE DECOMPOSITION AERODYNAMIQUE/ACOUSTIQUE]

L.-C. VALDES (ONERA, Chatillon, France) (Congres Francais d'Acoustique, 2nd, Arcachon, France, Apr. 14-16, 1992) ONERA, TP no. 1992-35, 1992, 5 p. In French. refs
(ONERA, TP NO. 1992-35)

It is assumed that the aerodynamic and acoustic components are each governed by the equations of perfect gas dynamics. A propagation equation is deduced for computing the acoustic field, if the overall velocity and temperature fields are known. The consequences of that hypothesis are examined when the air is at rest. An equation is established for determining the acoustic field of subsonic or transonic flows. Author

A92-48601

INFLUENCE OF GEOMETRICAL PARAMETERS ON HELICOPTER ROTOR HIGH SPEED IMPULSIVE NOISE

J. PRIEUR and C. POLACSEK (ONERA, Chatillon, France) (DGLR and AIAA, Aeroacoustics Conference, 14th, Aachen, Federal Republic of Germany, May 11-14, 1992) ONERA, TP no. 1992-40, 1992, 10 p. refs
(ONERA, TP NO. 1992-40)

The radiation of impulsive noise from helicopter rotors in high speed forward flight, as well as global performance, is largely influenced by blade geometry. A review of theoretical effort in this field and examples mainly taken from ONERA experimental wind tunnel studies are presented. The benefit in terms of noise reduction, provided by an advanced geometry, is assessed and compared to what is obtained by lowering the rotation speed. Wind tunnel acoustic studies also show that the designs of low noise blade geometries either for descent flight, or for high speed are not inevitably antithetical. Author

A92-52847

PROGRESS TOWARDS QUIETER CIVIL HELICOPTERS

M. V. LOWSON (Bristol, University, United Kingdom) (European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-27, 1991) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 956, June-July 1992, p. 209-223. refs
Copyright

A review of recent developments in helicopter noise reduction is presented. The paper includes a discussion of the present state of understanding of helicopter noise radiation mechanisms and a review of actual noise reductions achieved by the manufacturers over the past decade. An analysis of progress achieved in meeting certification limits is given, together with an evaluation of the impact on design. Future trends in helicopter noise reduction based on current noise research programs are discussed and suggestions advanced for possible additional areas of study. Author

A92-54484

THE INTERACTION BETWEEN A HIGH-FREQUENCY GUST AND A BLADE ROW

N. PEAKE (Cambridge, University, United Kingdom) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 241, Aug. 1992, p. 261-289. Research supported by SERC and Rolls-Royce, PLC. refs
Copyright

An asymptotic method for predicting the unsteady lift on a blade row due to the interaction with a convected vorticity wave was developed using the Wiener-Hopf technique for the case when

the reduced frequency, Ω , is large. This allowed the application of asymptotic analysis in the formal limit Ω approaching infinity, with a result of considerable simplification. It is shown that the formulas developed can be easily incorporated into existing noise prediction codes. The advantage of the asymptotic approach lies in the fact that it can handle high-frequency regimes for which conventional numerical approaches may become unwieldy, but for which cascade effects can still be highly significant. The approach can be used for modeling other effects such as rotor blockage. I.S.

A92-56169

EXPERIMENTAL STUDY OF NOISE GENERATION AND PROPAGATION IN A TURBOFAN MODEL

S. LEWY, S. CANARD-CARUANA (ONERA, Chatillon, France), and J. JULLIARD (SNECMA, Moissy-Cramayel, France) *Journal of Aircraft* (ISSN 0021-8669), vol. 29, no. 5, Sept.-Oct. 1992, p. 892-898. Research supported by Service Technique des Programmes Aeronautiques and Direction Generale de l'Aviation Civile. Previously cited in issue 02, p. 230, Accession no. A91-12466. refs
(ONERA, TP NO. 1992-199) Copyright

A92-56344* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

BVI IMPULSIVE NOISE REDUCTION BY HIGHER HARMONIC PITCH CONTROL - RESULTS OF A SCALED MODEL ROTOR EXPERIMENT IN THE DNW

WOLF R. SPLETTSTOESSER, KLAUS-J. SCHULTZ, ROLAND KUBE (DLR, Braunschweig, Germany), THOMAS F. BROOKS, EARL R. BOOTH, JR. (NASA, Langley Research Center, Hampton, VA), GEORG NIESL (MBB GmbH, Ottobrunn, Germany), and OLIVIER STREBY (Aerospatiale, Marignane, France) *European Rotorcraft Forum*, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 14 p. refs

Results are presented of a model rotor acoustics test performed to examine the benefit of higher harmonic control (HHC) of blade pitch to reduce blade-vortex interaction (BVI) impulsive noise. A dynamically scaled, four-bladed, rigid rotor model, a 40-percent replica of the B0-105 main rotor, was tested in the German Dutch Wind Tunnel. Noise characteristics and noise directivity patterns as well as vibratory loads were measured and used to demonstrate the changes when different HHC schedules were applied. Dramatic changes of the acoustic signatures and the noise radiation directivity with the HHC phase variations are found. Compared to the baseline conditions (without HHC), significant mid-frequency noise reductions of locally 6 dB are obtained for low-speed descent conditions where GVI is most intense. For other rotor operating conditions with less intense BVI there is less or no benefit from the use of HHC. LF noise and vibratory loads, especially at optimum noise reduction control settings, are found to increase. C.A.B.

N92-10602*# Southampton Univ. (England).

JET NOISE CLASSICAL THEORY AND EXPERIMENTS

G. M. LILLEY *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 211-289 Aug. 1991
Avail: CASI HC A05/MF A06

Lighthill's theory of aerodynamic noise is presented as the foundation on which to build all other theories of aerodynamic noise. The application of the Lighthill acoustic analogy to the estimation of the characteristics of the noise radiated from the jets is central. Attention is given to the assumptions on which the Lighthill acoustic analogy is based and it is shown why the theory gives results different from experiment when flow-acoustic interaction occurs. The details of flow-acoustic interaction are invariably unavailable to provide the necessary fine adjustments to the Lighthill source function to render it such that the noise radiation as calculated is exact. The alternative approaches to the understanding of aerodynamic noise theory are discussed. The emphasis is placed on the flow-acoustic interaction and such theories as are required to complement the results obtained by application of Lighthill's acoustic analogy. The authors discuss

some of the dominant features of the mean flow and the turbulent structure of a jet as a guide to modeling the T sub ij four-order covariance, which is central to applications involving Lighthill's acoustic analogy. The results obtained from the acoustic analogy model are compared with experimental data obtained by application of the polar correlation technique to both a model-scale jet and a full-scale jet engine. The relatively close agreement is evidence that the flow field data are pertinent to the description of the acoustic analogy model. A brief description is given of attempts to reduce jet noise without incurring an undue penalty in the loss of nozzle efficiency. Finally, the importance of good, reliable, and accurate experimental data in all studies of aerodynamic noise is stressed. Author

N92-10605*# Cambridge Univ. (England).

AIRFRAME NOISE

DAVID G. CRIGHTON *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 1: Noise Sources p 391-447 Aug. 1991

Avail: CASI HC A04/MF A06

Current understanding of airframe noise was reviewed as represented by experiment at model and full scale, by theoretical modeling, and by empirical correlation models. The principal component sources are associated with the trailing edges of wing and tail, deflected trailing edge flaps, flap side edges, leading edge flaps or slats, undercarriage gear elements, gear wheel wells, fuselage and wing boundary layers, and panel vibration, together with many minor protrusions like radio antennas and air conditioning intakes which may contribute significantly to perceived noise. There are also possibilities for interactions between the various mechanisms. With current engine technology, the principal airframe noise mechanisms dominate only at low frequencies, typically less than 1 kHz and often much lower, but further reduction of turbomachinery noise in particular may make airframe noise the principal element of approach noise at frequencies in the sensitive range. Author

N92-12599# Aeronautical Research Inst. of Sweden, Stockholm. Structure Dept.

ACOUSTIC CHARACTERISTICS OF ANECHOIC CHAMBER AT FFA

LARS GUSTAVSSON Nov. 1990 57 p
(FFA-TN-1990-43; ETN-91-90284) Avail: CASI HC A04/MF A01

The acoustical characteristics of the FFA (Swedish aeronautical research institute) anechoic chamber are described. The chamber is measured according to the requirements of ISO standard 3745 as a precision anechoic chamber. It is shown that these requirements are fulfilled in the frequency range 80 to 10,000 Hz, with a distance between the source and the microphone up to 10 m. The report may be used to choose the best measure path in the chamber at each frequency, which is especially useful at other frequencies than those which are defined in ISO 3745. Different absorbing treatments applied to the rail construction are analyzed and useable treatments are suggested. Measure paths are described in the frequency range 40 to 80 Hz, which do not fulfill the requirements in ISO 3745 but still could be used at propagation measurements with lower requirements than according to ISO 3745. ESA

N92-12601# Aeronautical Research Inst. of Sweden, Stockholm. Aeronautics Dept.

AEROACOUSTICS IN INHOMOGENEOUS FLOW FIELD

PEJE LOEFGREN Aug. 1991 20 p

(Contract STU-90-03619P)

(FFA-TN-1991-30; ETN-91-90289) Avail: CASI HC A03/MF A01

A contribution to the study of the possibility to extend an existing computational method for aeroacoustics in a homogeneous flow field to more general cases of inhomogeneous flow is given. The existing method is characterized by the use of convolution technique, at which the fundamental solution of the wave equation plays an important role. A linear first order Partial Differential Equation (PDE) system, valid in the weak sense in the whole of space time, is derived for aeroacoustics in a stationary

inhomogeneous flow field. Because of the inhomogeneity some of the coefficients of the system are not constants, which excludes the possibility to eliminate the perturbations velocity in order to get a single equation for the perturbation mass density (as in the homogeneous case) as well as the possibility to solve the system by conventional convolution technique. ESA

N92-15013# Naples Univ. (Italy).

LINEAR ACOUSTICS IN GAS MIXTURES WITH RATE PROCESSES

LUIGI G. NAPOLITANO *In* ESA, Aerothermodynamics for Space Vehicles p 317-324 Jul. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Linear acoustics in an unbounded medium in which an arbitrary number of independent rate processes (chemical reactions and/or excitations on internal degrees of freedom) take place are dealt with. The medium is supposed to be in an initial quiescent and full equilibrium state and all diffusion processes are assumed to be negligible. (Linear acoustics without neglectation of diffusion processes or in nonquiescent media and nonlinear acoustics with and without diffusion processes are not dealt with). The extremely simplified case dealt with is nonetheless very useful. It allows for the following: elucidation of the role played by a number of basic notions of thermodynamics such as equilibrium and stability; quantification of the 'response' of the media to small disturbances; and suggestion of diagnostic techniques which may be used to study the kinetics of rate processes and their couplings, and so forth. Equilibrium and nonequilibrium thermodynamics of composite systems as specialized to the subject case are considered. The field equations and their linearized form appropriate to the study of linear acoustics are addressed, as are the general features of linear acoustics, dispersion equation, and properties of the acoustic susceptibility. ESA

N92-18074 ESDU International Ltd., London (England).

PREDICTION OF FAR-FIELD HARMONIC NOISE FROM PROPELLERS Abstract Only

Nov. 1991 17 p

(ISSN 0307-0115)

(ESDU-91033; ISBN-0-85679-795-2) Avail: ESDU

A FORTRAN program for estimating the discrete frequency free-field noise from an isolated straight blade single propeller which is in uniform motion or stationary in a lossless atmosphere is given. Blade sweep is unlikely, however, to have a significant effect up to tip Mach numbers of 0.9. It is assumed that the noise sources are compact chordwise so that they are line sources; that assumption excludes advanced propellers and prop fans. The input to the program is ambient static pressure and temperature, source/receiver relative geometry, propeller operating conditions, and blade geometry and lift coefficient at a number of radial stations. If the load distribution is not known, a default distribution is provided for which power supplied and propeller thrust generated is required. Predictions are compared with available limited data measured in a wind-tunnel, and a sketch shows a typical correlation. The program is provided on disc as ESDUpac 9133, and information is given on the format for the input and output, illustrated by two worked examples. A graphical method for the maximum harmonic levels from a static propeller is given in ESDU 76020. ESDU

N92-20387# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de la Physique Generale.

DEFINITION OF ACOUSTIC MEASUREMENTS IN THE ANECHOIC CHAMBER OF PALAISEAU (FRANCE) AND THE WIND TUNNEL AT NANTES (FRANCE) [DEFINITION DE MESURES TECHNIQUES EN CHAMBRE ANECHOIQUE A PALAISEAU ET EN SOUFFLERIE A NANTES]

P. MALBEQUI, Y. DELRIEUX, and S. CANARD-CARUANA Feb. 1991 12 p *In* FRENCH

(Contract DRET-89-001-118)

(ONERA-RT-16/3641-PY; ETN-92-90875) Avail: CASI HC

A03/MF A01

Software developed to take three dimensional effects into

account in the study of acoustic propagation at low latitudes is described. The basic experiments on diffraction due to obstacles and propagation in the presence of cross wind are described. These experiments are carried out in an anechoic chamber wind tunnel. ESA

N92-20461# Rolls-Royce Ltd., Derby (England).

THE IMPACT OF AIRCRAFT NOISE CONTROL TECHNOLOGY

M. J. T. SMITH 7 May 1991 9 p Presented at the Canadian Aeronautics and Space Seminar, Montreal, Quebec, 7 May 1991 (PNR-90846; ETN-92-90796) Copyright Avail: CASI HC

A02/MF A01

Reductions made in aircraft noise since the first generation jet aircraft are reviewed. The critical facts presently underpinning the airport noise situation are listed. The technologies which are responsible for the reduction in aircraft noise are reviewed and illustrated. Progress in noise control around airports is considered and future prospects concerning aircraft noise are discussed. ESA

N92-21237# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

AERODYNAMICALLY GENERATED ACOUSTIC RESONANCE IN A PIPE WITH ANNULAR FLOW ENLARGEMENTS AND RESTRICTORS

A. K. STUBOS, E. PALLI, C. BENOCCI, and D. OLIVARI Sep. 1991 40 p Sponsored by BPD

(VKI-TN-178; ETN-92-91062) Avail: CASI HC A03/MF A01

The coupling between fluid dynamic instabilities and an acoustic field for the case of flow within a pipe with annular restrictions is studied. It is found that two different behaviors may exist, depending on the distance between restrictors, and that the fluid flow can amplify the acoustic perturbations at the frequencies of the acoustic modes when the two restrictors are close enough. A physical explanation is proposed, linking the amplification of an acoustic perturbation to the phase and frequency of vortex shedding from the restrictors, and a general predictive model is found giving the critical Strouhal number of the phenomenon for any height of restrictor. ESA

N92-21736# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Direction de la Physique Generale.

PREDICTION OF HELICOPTER NOISE: ADAPTATION OF NOISE LOAD CALCULATIONS TO THE BLADE-VORTEX INTERACTION Summary Report [PREVISION DU BRUIT DES HELICOPTERES: ADAPTATION DU CALCUL DE BRUIT DE CHARGE A L'INTERACTION PALE-TOURBILLON. RAPPORT DE SYNTHESE]

P. SPIEGEL Jan. 1991 45 p *In* FRENCH

(Contract DRET-89-001-118)

(ONERA-RS-97/5094-PY; ETN-92-90872) Avail: CASI HC A03/MF A01

The techniques used in predicting the noise produced by turbine motor helicopters are reviewed. Prediction of the noise produced by the interaction of the main rotor blades and the air vortex is given particular attention. The predictions are made based on pressure values generated by the DIPTTEST simulation program. The quality of aerodynamic data required to carry out any acoustic calculations using the DIPTTEST program, is defined. Smoothing of pressure coefficients allows a clean acoustic signal to be obtained, which faithfully reflects the physics involved in the phenomenon. ESA

N92-21773# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

WAVE ACOUSTICS FOR PROPAGATION OF ULTRASOUND ALONG A VORTEX ARRAY IN SUPERFLUID HE-3

E. B. SONIN, K. TORIZUKA, J. M. KYNAERAEINEN, J. P. PEKOLA, and G. K. TVALASHVILI 22 Apr. 1991 31 p Prepared

in cooperation with Akademiya Nauk Gruzinskoi SSR, Tiflis (PB92-134147; TKK-F-A684; ISBN-951-22-0607-2) Avail: CASI HC A03/MF A01

A wave-acoustics theory was developed to describe the

propagation of zero sound parallel to vortex lines in rotating He-3. It is shown that diffraction 'shadow' is formed in which the wave amplitude is suppressed by interference around vortices. The phenomenon contributes to the experimentally observed effect of rotation on the sound amplitude and exceeds the attenuation at large core radii. The dependence of the diffraction contribution on the angular velocity changes drastically at the transition from vortices with a finite core to coreless vortices when the magnetic field is decreased to zero. Conditions for the applicability of the classical geometrical acoustic method in describing zero sound propagation in a vortex array are derived. GRA

N92-22241# Southampton Univ. (England). Audiology and Human Effects Group.

RISK TO HEARING FROM OVERFLIGHT NOISE OF MILITARY AIRCRAFT

B. W. LAWTON and D. W. ROBINSON May 1991 56 p
Sponsored by Ministry of Defence
(ISVR-TR-194; ETN-92-91197) Avail: CASI HC A04/MF A01

The maximum level of aircraft noise to which the ear can be exposed without significant permanent noise induced hearing loss was investigated. A systematic database search is described. This search failed to reveal any published reports of permanent hearing threshold shift due to aircraft noise. However, some evidence exists that a small amount of temporary threshold shift may be induced by noise at levels in the region of 125 dB(A), which would nevertheless be without permanent effect. By characterizing overflight noise by its total exposure value (taking into account overflight duration), comparisons are made with existing damage risk criteria. Predictions of permanent threshold shift, using established relationships, suggest that there is no credible risk to hearing even for long term repeated exposures on the basis of several events per day at 125 dB(A). The nature of the relationship between noise exposure and permanent threshold shift, as it relates to the most susceptible fraction of an exposed population, inhibits the specification of a unique level which would guarantee total freedom from noise induced hearing loss in every individual. However, there appears to be a practical margin of safety in the case of aircraft noise producing a maximum level of 125 dB(A) during the overflight. The conclusion rests upon experimental evidence of the course of noise level versus time, typical of military aircraft overflights. Taking the margin of safety into account, recommendations are made which, while suggesting that the existing criterion value be maintained, offer guidance on its interpretation and practical implementation. ESA

N92-29201# Cambridge Univ. (England). Dept. of Engineering.

BOUNDARY LAYER INDUCED NOISE IN AIRCRAFT

W. R. GRAHAM May 1992 345 p
(ISSN 0309-7293)
(CUED/A-AERO/TR-18) Avail: CASI HC A15/MF A03

The aim of this research is to investigate ways of controlling boundary layer induced noise at the design stage, as the problem is much harder to treat after it has become apparent. In order to achieve this, it is essential to be able to model the noise generation process successfully, preferably in such a way that our physical understanding of the problem is enhanced, since without this understanding the formulation of general design guidelines is almost impossible. At present, although a large body of research germane to the problem exists, there is no such model, and the development of one is, thus, the first requirement of this work. Once the model is complete and validated, the question of noise limitation may be addressed. The reduction of the boundary layer induced noise problem in aircraft to an initial model problem, which may be formulated in general terms, and the subsequent further approximations that may be made to achieve a form simple enough to facilitate understanding of the results while retaining the necessary features of the problem are described. Author

N92-29997# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abteilung Technische Akustik.

JET AIRCRAFT NOISE AT HIGH SUBSONIC FLIGHT MACH NUMBERS [DER LAERM VON STRAHLFLUGZEUGEN BEI HOHEN UNTERSCHALL-FLUGMACHZAHLEN]

JAN BOETTCHER and ULF MICHEL Aug. 1991 94 p In GEORGIAN

(ISSN 0939-2963)

(DLR-FB-91-28; ETN-92-91733) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC

Acoustic overfly measurements are carried out and analyzed to identify the sound sources of the noise development by means of their spectral radiation properties. The extension of existing prediction schemes for the radiation mixing and the broadband shock noise is discussed on the basis of experimental results. Measure and calculation results were compared and a good agreement was found for the time profiles of noise levels, the frequency spectra, and the total sound pressure level as a function of emission angle. The prediction schema could be used to demonstrate the influence of operational parameters and quantify the noise production. It is shown that a decrease in flight Mach number and an increase of flight height cause an important noise reduction. ESA

N92-32952*# Saab Aircraft Co., Linköping (Sweden).

VIBRO-ACOUSTIC FE ANALYSES OF THE SAAB 2000 AIRCRAFT

INGE S. GREEN In NASA. Langley Research Center, Fourth Aircraft Interior Noise Workshop p 44-69 Jul. 1992
Avail: CASI HC A03/MF A03

A finite element model of the Saab 2000 fuselage structure and interior cavity has been created in order to compute the noise level in the passenger cabin due to propeller noise. Areas covered in viewgraph format include the following: coupled acoustic/structural noise; data base creation; frequency response analysis; model validation; and planned analyses. H.A.

N92-32956*# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).

ADVANCED STUDY FOR ACTIVE NOISE CONTROL IN AIRCRAFT (ASANCA)

INGO U. BORCHERS, URBAN EMBORG (Saab Aircraft Co., Linköping, Sweden), ANTONIO SOLLO (Alenia Spazio S.p.A., Naples, Italy), ELLY H. WATERMAN (Fokker B.V., Schiphol-Oost, Netherlands), JACQUES PAILLARD (MATRA Sep Imagerie et Informatique, Saint Quentin en Yvelines, France), PETER N. LARSEN (Reson System A/S, Slangerup, Denmark), GERARD VENET (METRAVIB, Ecully, France), PETER GOERANSSON (Aeronautical Research Inst. of Sweden, Bromma), and VINCENT MARTIN (Centre National de la Recherche Scientifique, Marseilles, France) In NASA. Langley Research Center, Fourth Aircraft Interior Noise Workshop p 129-141 Jul. 1992

(Contract EEC-AERO-0028-C)

(AIAA PAPER 92-2092) Avail: CASI HC A03/MF A03

Aircraft interior noise and vibration measurements are included in this paper from ground and flight tests. In addition, related initial noise calculations with and without active noise control are conducted. The results obtained to date indicate that active noise control may be an effective means for reducing the critical low frequency aircraft noise. Author

N92-32960*# Deutsche Lufthansa A.G., Frankfurt am Main (Germany).

PILOTS NOISE EXPOSURE DURING A BOEING 747-400 ROUND TRIP: AMBIENT NOISE AND ACOUSTIC-HEAD RECORDING AND ANALYSIS OF DATA

KNUT HOFFMAN In NASA. Langley Research Center, Fourth Aircraft Interior Noise Workshop p 211-227 Jul. 1992
Avail: CASI HC A03/MF A03

Pilot noise exposure is examined during the round trip flight of a Boeing 747-400 aircraft. Although the sound power origin is the aircraft, this paper examines the effects of this noise on the human

occupants within the airplane. Data is acquired and analyzed to determine the noise exposure of pilots on long flights, in this case, a flight of 12 hours and 20 minutes. All results are presented in viewgraph format. H.A.

N92-32961*# Deutsche Insurance Germany (F.R.).
PILOT NOISE EXPOSURE DURING A BOEING 747-400 ROUND TRIP: JUDGEMENT OF NOISE AND ANALYSIS IN RESPECT TO HEARING IMPAIRMENT OF PILOTS

HANS JUERGEN HOOMAN *In* NASA. Langley Research Center, Fourth Aircraft Interior Noise Workshop p 228-251 Jul. 1992
 Avail: CASI HC A03/MF A03

Noise level measurements are made on Boeing 747 aircraft to determine the potential hazards to airline pilots. Measuring results have shown that most pilots work under conditions that where noise constitutes a health hazard. Long and short term effects of noise exposure in pilots is examined as well as the legal ramifications of this potential hazard. H.A.

N92-32962*# Alenia Aeronautica, Naples (Italy).
ACTIVE VIBRATIONS AND NOISE CONTROL FOR TURBOPROP APPLICATION RESEARCH PROGRAM ACTIVITIES

A. PAONESSA, A. CONCILIO (Italian Aerospace Research Center, Naples.), and LEONARDO V. LECCE (Istituto Progetto Velivoli, Naples, Italy) *In* NASA. Langley Research Center, Fourth Aircraft Interior Noise Workshop p 252-294 Jul. 1992
 Avail: CASI HC A03/MF A03

The objectives of this work include the following: (1) development of active noise control techniques to alleviate inefficiencies and drawbacks of passive noise control approach especially at low frequencies; (2) reduction of structurally radiated noise applying external forces to the vibrating structure by means of force actuators made of piezoelectric material; and (3) reduction of fuselage vibration levels in propeller driven aircraft by means of distributed piezoelectric actuators that are actively controlled. H.A.

72

ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-10476# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

VORTEX NUCLEATION IN ROTATING SUPERFLUID HE-3-B

Abstract Only

U. PARTS, Y. M. BUNKOV, Y. KONDO, N. B. KOPNIN, J. S. KORHONEN, M. KRUSIUS, and D. A. SERGATSKOV *In* Oulu Univ., Proceedings of the 25th Annual Conference of the Finnish Physical Society 1 p 1991
 Avail: CASI HC A01/MF A03

The nucleation of quantized vortices with a singular core has proven to be a frustrated process in both the A and B phases of superfluid He-3. In He-3-A coreless continuous vortices are prevailing, although they are assumed to correspond to a higher energy state. The thermally activated process and the critical velocity for the surface energy barrier are identified for vortex nucleation in vortex free superflow of He-3-B. ESA

N92-10479# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

SUPERFLUID VORTEX NUCLEATION IN HE-3 FLOW Abstract Only

P. I. SOININEN (Helsinki Univ. of Technology, Espoo (Finland).), N. B. KOPNIN (Landau Inst. for Theoretical Physics, Moscow, USSR), and M. M. SALOMAA *In* Oulu Univ., Proceedings of the 25th

Annual Conference of the Finnish Physical Society 1 p 1991

Avail: CASI HC A01/MF A03

Computer simulations for superfluid vortex formation in He-3 flow through narrow channels are described. Phase slippage is found to occur through vortex formation and motion. The dynamics of the order parameter field is described by the Time Dependent Ginzburg-Landau (TDGL) equation, with a chemical potential term to guarantee gauge invariance. The chemical potential is calculated assuming that the normal component executes Knudsen flow. This constitutes the simplest physical model for the multicomponent order parameter dynamics in superfluid He-3. The numerical results confirm Anderson's proposal. In particular, vortex creation is found in the flow channel; phase slip lines are predicted in narrow channels. ESA

N92-21788# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).

EXISTENCE OF NON-TOPOLOGICAL SOLITONS IN THE SELF-DUAL CHERN-SIMONS THEORY

J. SPRUCK and Y. YANG Nov. 1991 24 p Prepared in cooperation with Massachusetts Univ., Amherst, and New Mexico Univ., Albuquerque
 (Contract DE-FG02-86ER-250125; NSF DMS-88-02858)
 (PB92-134402; IHES/M/91/81) Avail: CASI HC A03/MF A01

In the recently discovered (2+1) dimensional relativistic Chern-Simons model, self duality can be achieved when the Higgs potential density assumes a special form for which both the asymmetric and symmetric vacua are ground state solutions. This important feature may imply the coexistence of static topological and nontopological vortex-like solutions in R(sup 2) but the latter have been rather elusive to a rigorous construction. An attempt was made to prove the existence of nontopological radially symmetric N-vortex solutions in the self-dual Chern-Simons model. By a shooting method, one obtains a continuous family of gauge distinct N-vortex solutions. Moreover, one is also able to classify all possible bare (or 0-vortex) solutions. Author

N92-23295*# Royal Aircraft Establishment, Farnborough (England). Space Dept.

SURFACE ACTIVATION OF CONCORDE BY BE-7

P. R. TRUSCOTT, C. S. DYER, and J. C. FLATMAN *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 1 p 249-254 Jan. 1992

Activation analysis of two airframe components from the Concorde aircraft has identified the presence of Be-7, a nuclide found by other investigators that was deposited on the forward edge of the Long Duration Exposure Facility (LDEF) structure. The results of the Concorde analysis indicate that this phenomenon is very much a surface effect, and that the areal densities of the Be-7 are comparable to those found for LDEF. The collection of Be-7 by the aircraft must be greater than in the case of LDEF (since duration for which Concorde is accumulating the nuclide is shorter) and is of the order of 1.2 to 41 nuclei/sq cm(-)s(exp -1) depending upon assumptions made regarding the altitude at which collection becomes appreciable, and the efficiency of the process which removes the radionuclide. D.R.D.

N92-27231*# Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).

LDEF: DOSIMETRIC MEASUREMENT RESULTS (AO 138-7 EXPERIMENT) Abstract Only

J. BOURRIEAU *In* NASA. Langley Research Center, Second LDEF Post-Retrieval Symposium Abstracts p 17 Jun. 1992
 Avail: CASI HC A01/MF A02

One of the objectives of the AO 138-7 experiment on board the LDEF was a total dose measurement with Thermo Luminescent Detectors (TLD 100). Two identical cases, both including 5 TLDs inside various aluminum shields, are exposed to the space environment in order to obtain the absorbed dose profile induced. Radiation fluence received during the total mission length was computed, taking into account the trapped particles (solar maximum and solar minimum periods) and the cosmic rays; due to the magnetospheric shielding, the solar proton fluences are negligible

on the LDEF orbit. The total dose induced by these radiations inside a semi-infinite plane shield of Al are computed with radiation transport codes. TLD reading are performed after flight; due to the mission duration increase, a post-flight calibration was necessary in order to cover the range of the flight induced dose. The results obtained, similar (+ or - 30 pct.) in both cases, are compared with the dose profile computation. In practice, these LDEF results, with less than a factor 1.4 between measurements and forecasts, reinforce the validity of the computation methods and models used for the long term evaluation of space radiation intensity on low inclination Earth orbits. Author

N92-27284*# Manchester Univ. (England). Dept. of Geology.
OXYGEN ISOTOPES IMPLANTED IN THE LDEF SPACECRAFT
Abstract Only

J. M. SAXTON, I. C. LYON, E. CHATZITHEODORIS, J. D. GILMOUR, and G. TURNER /in NASA. Langley Research Center, Second LDEF Post-Retrieval Symposium Abstracts p 78 Jun. 1992

Avail: CASI HC A01/MF A02

Depth profiles of O-16 and O-18/O-16 were measured on stainless steel nuts and copper sheet (from a grounding strap) recovered from the leading edge of LDEF (Tray E10). The measurements were obtained by dynamic SIMS (secondary ion mass spectrometry) using a VG Isolab 54 ion microprobe. Plots of O-18/O-16 against time, show large depletions of up to a factor of 2 compared to the O-18/O-16 value at sea level. The O-16 current decreases by 2 orders of magnitude in the interior of the metal, and the corresponding profile of anomalous O-16 is strongly peaked in the outer few tens of nanometers of the surface. This depth scale is a tentative one based on estimated sputtering rates. Plots of O-18/O-16 against 1/O-16 should be linear if two isotopically distinct components, one of variable concentration (orbital component) and one of fixed concentration (normal oxygen), are mixed. Data to be presented at the meeting show departures from linearity which result from variability in the concentration of normal oxygen, but may also arise from the implantation of oxygen with a range of fractionation due to the decaying orbit of the LDEF, sputtering of the surface by atomic oxygen, and the different momenta of the two isotopes due to their equal velocities. The potential for using this method as a means of identifying exposure to low-Earth orbit, deconvoluting the effects of space exposure from terrestrial contamination, and using the implanted anomalous oxygen as a means of studying the atomic oxygen density and upper atmosphere temperature height profile will be discussed at the meeting. Author

74

OPTICS

Includes light phenomena; and optical devices.

A92-17891
VORTICES AND DEFECT STATISTICS IN TWO-DIMENSIONAL OPTICAL CHAOS

F. T. ARECCHI, G. GIACOMELLI, P. L. RAMAZZA, and S. RESIDORI (Istituto Nazionale di Ottica, Florence, Italy) Physical Review Letters (ISSN 0031-9007), vol. 67, Dec. 30, 1991, p. 3749-3752. refs

Copyright

The first direct experimental evidence of topological defects in nonlinear optics is presented. For increasing Fresnel numbers F , the two-dimensional field is characterized by an increasing number of topological defects, from a single vortex up to a large number of vortices with zero net topological charge. At variance with linear scattering from a fixed phase plate, here the defect pattern evolves in time according to the nonlinear dynamics. The scaling exponents are assigned for the mean number of defects, their mean

separation, and the charge unbalance as functions of F , as well as the correlation time of the defect pattern. Author

A92-29392
COMPUTER SIMULATION OF ABSOLUTE AND CONTRAST INFRARED SIGNATURES FROM MISSILE NOSES

ALESSANDRO TOFANI (Livorno Hospital, Italy) Optical Engineering (ISSN 0091-3286), vol. 31, March 1992, p. 562-566. refs

Copyright

A computer simulation was performed to obtain an estimate of the infrared radiant intensity and radiative contrast produced by missile noses. The temperature distribution on the nose was computed by taking into account the effects of aerodynamic and solar heating, sky irradiance, and radiative cooling. The corresponding absolute and contrast signatures were obtained by considering the influence of both atmosphere and target geometry, for six target classes, including cruise missiles, tactical ballistic missiles, and air-to-air and surface-to-surface missiles. Both radiant intensity and radiative contrast were computed as a function of missile altitude or missile distance for all targets. A comparison of radiative quantities in the 3- to 5-micron and 8- to 12-micron bands shows that usually the spectral region that gives the strongest signal is not the one that gives the highest contrast. Author

A92-52965
THE NEAR MILLIMETRE WAVELENGTH OPTICAL CONSTANTS OF CALCIUM LANTHANUM SULPHIDE

J. R. BIRCH (National Physical Laboratory, Teddington, United Kingdom), J. A. SAVAGE (Defence Research Agency, Electronics Div., Malvern, United Kingdom), A. E. J. WILSON, and C. J. BRIERLEY (GEC-Marconi Materials Technology, Ltd., Towcester, United Kingdom) Infrared Physics (ISSN 0020-0891), vol. 33, no. 5, Sept. 1992, p. 437-441. Research supported by National Measurement System Policy Unit. refs

Copyright

Spectroscopic measurements at near millimeter wavelengths made on calcium lanthanum sulphide, a potential material for infrared window applications in high speed aircraft, have revealed a region of transparency below 40/cm. The optical constants of the material have been measured from 5 to 40/cm at 293 K, in order to consider its suitability for near millimeters wavelength applications. Author

N92-27108*# Reading Univ. (England). Infrared Multilayer Lab.
EXPOSURE TO SPACE RADIATION OF HIGH-PERFORMANCE INFRARED MULTILAYER FILTERS AND MATERIALS TECHNOLOGY EXPERIMENT (A0056)

GARY J. HAWKINS, JOHN S. SEELEY, and ROGER HUNNEMAN /in NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 3 p 1477-1491 Jan. 1992

Avail: CASI HC A03/MF A04; 1 functional color page

Infrared optical multilayer filters and materials were exposed to the space environment of low Earth orbit on LDEF. The effects are summarized of that environment on the physical and optical properties of the filters and materials flown. Author

75

PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

A92-33574
A FAMILY OF TWO-DIMENSIONAL NONLINEAR SOLUTIONS FOR MAGNETIC FIELD ANNIHILATION

M. JARDINE (Sussex, University, Brighton, England), H. R. ALLEN, R. E. GRUNDY, and E. R. PRIEST (Saint Andrews, University,

Scotland) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A4, April 1, 1992, p. 4199-4207. refs
Copyright

The paper presents a family of nonlinear solutions for magnetic field annihilation in two dimensions. These solutions include fully the effects of viscosity and resistivity and are a generalization of the Sonnerup and Priest model, where an irrotational stagnation point flow carries straight field lines toward a long, thin current sheet. The present solutions allow for vorticity in the inflow. When this is low, there is a unique solution for the flow and magnetic field. The current sheet adjusts its dimensions to accommodate different inflows. It is widest for a negative imposed vorticity and increases in width as the resistivity or viscosity is increased. When the imposed vorticity is large and negative, however, the solutions become nonunique, the flow pattern becomes cellular, and current sheets develop at the cell boundaries. These results show that it is possible to have many more different types of inflow matched to full solutions for the current sheet than have been considered hitherto. Author

A92-46982#
ROTATIONAL TEMPERATURE MEASUREMENTS OF N₂(+) IN AN ARC JET AT LOW PRESSURE

G. CERNOGORA, G. GOUSSET, L. HOCHARD (Paris XI, Université, Orsay, France), M. DUDECK, P. LASGORCEIX, and V. LAGO (CNRS, Laboratoire d'Aerothermique, Meudon, France) AIAA, Plasmadynamics and Lasers Conference, 23rd, Nashville, TN, July 6-8, 1992. 6 p. Research supported by CNRS. refs
(AIAA PAPER 92-2967) Copyright

Rotational temperature is measured by optical emission spectroscopy on a nitrogen arc jet. The arc jet velocity range from 2000 m/s to 5000 m/s at a static pressure from 0.1 torr to 10 torr. The first negative system is observed downstream of the plasma generator. A high-resolution 150-cm focal length monochromator is used to reduce line overlapping. The rotational temperature is measured by comparing the recorded spectra with the calculated one. The rotational temperature ranges from 3000 K to 10,000 K, depending on the arc power and position downstream. A small percentage of hydrogen is added to the nitrogen in order to observe the emission of NH and compare the rotational temperature of nitrogen and NH. Author

N92-70166 International Centre for Theoretical Physics, Trieste (Italy).

VISCOUS AND JOULE HEATING EFFECTS ON MHD FREE CONVECTION FLOW WITH VARIABLE PLATE TEMPERATURE
M. A. HOSSAIN Sep. 1990 14 p
(DE91-633612; IC-90/265) Avail: CASI HC A03/MF A01

A steady two-dimensional laminar boundary layer flow of a viscous, incompressible, and electrically conducting fluid past a vertical heated plate with variable temperature in the presence of a transverse uniform magnetic field has been investigated by bringing into the effect that of viscous and Joules heating. The non-dimensional boundary layer equations are solved using the implicit finite difference method along with Newton's approximation for a small Prandtl number chosen as typical of coolant liquid metals at operating temperature. DOE

76

SOLID-STATE PHYSICS

Includes superconductivity.

A92-11897
INTERACTION BETWEEN MOVING FLUX LINES AND A TWO-DIMENSIONAL ELECTRON GAS

G. H. KRUITHOF, P. C. VAN SON, and T. M. KLAPWIJK (Groningen, State University, Netherlands) Physical Review Letters (ISSN 0031-9007), vol. 67, Nov. 4, 1991, p. 2725-2728. Research

supported by Royal Netherlands Academy of Arts and Sciences. refs

Copyright

A novel method is presented to study the dynamics of vortices in superconducting films at fields close to the upper critical magnetic field. It is shown that moving flux lines in the gate of a superconductor-oxide-semiconductor field-effect transistor are magnetically coupled to a two-dimensional electron gas, leading to an induced voltage. The major part of this voltage is proportional to the magnetoresistance, which is varied by changing the Landau-level filling. A second part is independent of the electron density and is tentatively attributed to the Hall component of the resistivity tensor. Author

A92-52211
OBSERVATION OF INVERSE DOMAINS IN HIGH TC SUPERCONDUCTORS

TH. SCHUSTER, M. R. KOBLISCHKA, B. LUDSCHER, and H. KRONMUELLER (Max-Planck-Institut fuer Metallforschung, Stuttgart, Germany) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 4, Aug. 15, 1992, p. 1478-1485. refs
(Contract BMFT-13-N-57005) Copyright

Nucleation of domains of inverse polarity is observed in the remanent state of high T_c superconductors using the high-resolution Faraday effect (HRF). The remanent state consists of domains with trapped flux and of domains with opposite polarity, separated from each other by an annihilation zone. It is shown that the stray fields of microstructural defects contribute to the nucleation process. Using the capability of the HRF technique to observe dynamic processes, experimental evidence for the different signs of the vortices is given. The influence of the pinning forces on this behavior is also shown. Author

N92-10501# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

DYNAMICS OF VORTICES IN HIGH-TEMPERATURE SUPERCONDUCTORS Abstract Only

N. B. KOPININ (Landau Inst. for Theoretical Physics, Moscow, USSR) In Oulu Univ., Proceedings of the 25th Annual Conference of the Finnish Physical Society 1 p 1991
Avail: CASI HC A01/MF A03

The effects of the intrinsic pinning on the flux flow and flux creep for magnetic fields parallel or inclined with respect to the layers are considered. A simple theoretical model based on the Lawrence-Doniach theory for layered compounds, which can be used for calculating both energy barrier for thermally activated flux creep, and the flux flow conductivity of layered and anisotropic conductors, is discussed. ESA

N92-21635*# Max-Planck-Inst. fuer Festkoerperforschung, Stuttgart (Germany).

RIGID LEVITATION, FLUX PINNING, THERMAL DEPINNING AND FLUCTUATION IN HIGH-TC SUPERCONDUCTORS

E. H. BRANDT In NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 230-239 Jan. 1991
Avail: CASI HC A02/MF A04

Here, the author shows that the strong velocity-independent frictional force on a levitating superconductor and on any type-II superconductor moving in a homogeneous magnetic field is caused by pinning and depinning of the magnetic flux lines in its interior. Levitation may thus be used to investigate the pinning properties of a superconductor, and friction in a superconductor bearing may be minimized by choosing appropriate materials and geometries. Author

N92-22738# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

VORTEX LATTICE-VORTEX LIQUID STATES IN ANISOTROPIC HIGH-(T SUB C) SUPERCONDUCTORS

B. I. IVLEV, N. B. KOPININ, and M. M. SALOMAA 1990 20 p

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Sponsored by Suomen Akatemija, Helsinki, and Akad. Nauk SSSR, Moscow
(PB92-142421; TKK-F-A668) Avail: CASI HC A03/MF A01

The authors investigated vortex lattice structures in highly anisotropic superconductors for a situation where the vortices are slightly inclined with respect to the easy plane of the crystal. The equilibrium configuration is found to be a vortex lattice with a rhombic unit cell highly compressed along the direction perpendicular to the easy plane. The elastic modulus for a shear deformation along this direction is exponentially small, which should result in melting of the vortex lattice already at quite low temperatures. The authors discuss the implications of the theoretical results for experiments on the magnetization and on the angular dependence of the torque for anisotropic high T_c superconductors in an applied magnetic field. GRA

77

THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

A92-52701

RAREFIED GAS DYNAMICS; PROCEEDINGS OF THE 17TH INTERNATIONAL SYMPOSIUM, RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN, GERMANY, JULY 8-14, 1990

ALFRED E. BEYLICH, ED. (Aachen, Rheinisch-Westfaelische Technische Hochschule, Germany) Symposium supported by CEC, DFG, DLR, USAF, U.S. Army, et al. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, 1626 p. For individual items see A92-52702 to A92-52829. (ISBN 1-56081-122-6) Copyright

The topics discussed in this symposium on rarefied gas dynamics (RGD) include kinetic theory and the Boltzmann equation (fundamental studies), the kinetic theory of gas flow (transport phenomena and numerical aspects), the analysis of the RGD flow (the shock wave structure), the properties of rarefied atmospheres, and the polyatomic gases. Attention is given to the RGD plasma, external and internal RGD flows, numerical methods (an application of Monte Carlo direct simulation and discrete velocity methods) and numerical methods including internal degrees of freedom. Special consideration is given to the molecular dynamics and numerical techniques; the expansion flows (jets, plumes, interaction with surfaces); the properties of free jets (molecular beams); the formation and properties of clusters; condensation and evaporation (clusters and films); surface phenomena; gas-surface interactions; and instrumental development, experimental facilities, and RGD applications. I.S.

A92-52702

THE HAROLD GRAD LECTURE - MATHEMATICS AND THE BOLTZMANN EQUATION

CARLO CERCIGNANI (Milano, Politecnico, Milan, Italy) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 3-13. refs
Copyright

This lecture is an attempt to tie the recent developments of the mathematical aspects of kinetic theory with the contributions of Harold Grad. In particular, the theory of existence of solutions, the problem of trend to equilibrium, approximate analytical and numerical solutions are discussed. Author

A92-52739

TRANSPORT PHENOMENA IN RELAXING GAS MIXTURES - MODELS AND APPLICATIONS

RAYMOND BRUN (Aix-Marseille I, Universite, Marseille, France)

IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 379-390. refs

Copyright

A general Chapman-Enskog method is developed for the case of vibrational and chemical nonequilibrium flows, making it possible to calculate the transport terms for all degrees of nonequilibrium. The method is applied to the case of a pure gas in vibrational nonequilibrium. Three examples of nonequilibrium flows are proposed to illustrate the important variations of the transport terms in these types of flows and to show their effect on the flow quantities. I.S.

A92-52782

TRANSPORT COEFFICIENTS IN DISCRETE KINETIC THEORY AND COMPARISON WITH CLASSICAL FLUID DYNAMICS

PHILIPPE CHAUVAT and RENEE GATIGNOL (Paris VI, Universite, France) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 838-845. refs
(Contract DRET-89-1554)

Copyright

The paper considers discrete models of gases. The particle velocities belong to a given finite set of vectors. For these media, there are two descriptions: a microscopic description and a macroscopic description. Near the continuum, the macroscopic laws are given by the Chapman-Enskog method. In order to obtain a good agreement with the classical theory, a particular class of models called regular models is used. For coplanar models, both isotropic and regular, the paper computes the numerical values of transport coefficients, and compares these values with the classical ones. Author

80

SOCIAL SCIENCES (GENERAL)

Includes educational matters.

A92-33257#

THE USE OF LARGE TEAMS IN CONCEPTUAL AIRCRAFT DESIGN

RAY WHITFORD (Royal Military College of Science, Shrivenham, England) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 7 p. refs
(AIAA PAPER 92-1092) Copyright

The paper addresses the objectives, organization, and management of large group design projects. In this context 'large' implies teams of up to 15 students working on a single conceptual design over a period of eight months. The paper emphasizes the team-building and collaboration necessary to achieve joint and individual success. It also shows the benefits of a competitive (i.e., team vs team) environment. Details of how the teams are formed, reference to design activities, and recent projects are given. Continuous monitoring of progress via weekly, formally conducted meetings and regular presentations to senior UK aerospace, airline industry, and Royal Air Force personnel leads an air of project office realism. Author

A92-55806

MAIN ACTIVITIES CONDUCTED UNDER THE INTERNATIONAL SPACE YEAR PANEL OF EXPERTS ON EDUCATION AND APPLICATIONS

I. REVAH and D. FOURNY-DELLOYE (CNES, Paris, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p.

(IAF PAPER 92-0466) Copyright

The paper discusses the activities undertaken by the

International Space Year Panel of Experts on Education and Applications, cochaired by NASA and CNES. These activities fall into two categories: (1) space and education and (2) training in remote sensing applications. The nine projects set up in the category of space and education cover three areas: education in earth observation, education in space science, and education in space telecommunications. For the category of training in remote sensing applications, twelve projects were set up, for training in three main areas: monitoring and management of vegetation resources, geological risks and hazards, and environment and town planning. I.S.

N92-25786# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.

INTERNATIONAL SPACE UNIVERSITY: EXPERIENCES AND OBSERVATIONS DURING SUMMER 1989 (INTERNATIONAL SPACE UNIVERSITY: KOKEMUKSIA JA HUOMIOITA KESÄELTÄE 1989)

TERO SILLI /In Oulu Univ., Second Meeting of Finnish Space Researchers p 63-64 1990 In FINNISH
Avail: CASI HC A01/MF A01

An account of the activities of the International Space University (ISU) is given. Observations from the Summer of 1989 at the Louis Pasteur University, Strasbourg (France), are given. ESA

81

ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

A92-47974

PROCUREMENT DOUBTS THREATEN RESEARCH

BILL SWEETMAN and JOHN KELLER Interavia Aerospace Review (ISSN 0020-6512), vol. 47, July 1992, p. 12-14, 16, 18, 19, 21.
Copyright

An overview is presented of the areas and methods of application devoted to R&D by the various aerospace companies and government agencies. The opportunity and need for budget cuts are clear but so is the consensus for a strong national defense and commercial industry strength. At the core of the debate are concepts that include encouraging defense companies to apply their technologies to civil needs, and reconstituting by retaining capability in case the armed forces should require rapid modernization. It is noted that an HSCT type program would be revolutionary in reversing the usual military to commercial flow of new ideas in aerospace, probably to the advantage of both.

R.E.P.

N92-17198# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Groupe Consultatif pour la Recherche.

CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS, JULY 1990 ONWARDS

10 Sep. 1990 136 p In ENGLISH and FRENCH
(AGARD-CAL-90/2; ISBN-92-835-0575-1) Copyright Avail:
CASI HC A07/MF A02

A listing is presented of selected meetings which will assist members of the aeronautical and space community by informing them about many scheduled International Scientific and Technical meetings and help is provided in avoiding the need to consult several sources in order to find out what meetings have been planned, their dates, and locations. The AGARD calendar is published every six months, in June and December of each year.
Author

N92-17212# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS, JANUARY 1992 AND ONWARDS

1992 121 p In ENGLISH and FRENCH
(AGARD-CAL-92/1; ISBN-92-835-0651-0) Copyright Avail:
CASI HC A06/MF A02

A listing is presented of scheduled International Scientific and Technical meetings and helps in avoiding the need to consult several sources in order to find out what meetings have been planned, their dates and locations. Details concerning the meetings listed in this issue of the calendar were obtained from National and International Organizations which sponsor Aeronautical and Space meetings and from other sources. Author

N92-18619# Aerospatiale, Cannes (France).

CRITICALITY MANAGEMENT IN SPACE PROGRAMS

J. CHARRON, B. MARGUERIN, A. BENES, and D. GONZALEZ /In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 71-77 Aug. 1991
Copyright Avail: CASI HC A02/MF A03

To cope with the ever increasing complexity of space systems and economic constraints, the Aerospatiale company has developed Critical Items Ranking by Contribution Evaluation (CIRCE), a management model for critical items. The principle of CIRCE is based on a qualitative system approach, and on analysis of the products' environments. Using the proposed model, a program's critical items can be selectively ranked and optimal tradeoffs for actions to be taken during a program can be made visible to its program manager. Thanks to its high sensitivity and dynamic aspect, CIRCE is a true management tool. ESA

N92-18634# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Design Assurance Dept.

A MANAGERIAL APPROACH FOR RELIABILITY VERIFICATION OF MECHANICAL EQUIPMENT

GERHARD ALBRECHT /In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 165-167 Aug. 1991
(MBB-UK-0140-PUB; OTN-033148) Copyright Avail: CASI HC A01/MF A03

The verification of the required reliability of mechanical equipment is a difficult task in space programs since adequate statistical failure data covering the specific properties of mechanical equipment is usually not available. However, since straightforward demonstration of the reliability (reliability testing) for the individual equipment is not feasible in most cases for cost and time reasons, effective Reliability, Availability, Maintainability, and Safety (RAMS) management is needed to verify the reliability using test data and other available data. ESA

N92-18640# Saab Space A.B., Goeteborg (Sweden). Product Assurance Dept.

IMPLEMENTATION OF THE TOTAL QUALITY MANAGEMENT CONCEPT WITHIN SPACE BUSINESS

CLAES BERLIN /In ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium p 195-202 Aug. 1991
Copyright Avail: CASI HC A02/MF A03

During the 1980's the quality task within industry developed into Total Quality Management (TQM). TQM includes the complete operational quality process in the company. The basic elements of TQM are summarized. The TQM concept is defined. Top executive management TQM commitment and involvement of all employees in the TQM process is called for. Concepts, methods and strategies of TQM are presented based on five years of experience in an ongoing process at Saab Space. ESA

N92-20458# Rolls-Royce Ltd., Derby (England).

THE REQUIREMENTS AND MANAGEMENT OF QUALITY AUDITS AND REVIEWS

PETER H. SMITH 1 Nov. 1990 38 p Presented at the Seminar on Auditing and Assessment Standards, 10 Apr. 1990

81 ADMINISTRATION AND MANAGEMENT

(PNR-90840; ETN-92-90793) Copyright Avail: CASI HC A03/MF A01

A set of graphics from a seminar on auditing and assessment standards is presented. The requirements and management of quality audits and reviews are explained and highlighted. ESA

N92-20621 TECHLOG (France).

AGILE: AN EXPERT SYSTEM FOR LARGE SPACE PROJECT MANAGEMENT [AGILE, UN SYSTEME EXPERT D'AIDE A L'EXPLOITATION DES GRANDS PROJETS SPATIAUX]

PATRICK LESUEUR (Centre National d'Etudes Spatiales, Toulouse (France).), ELISABETH LAUTIER, and BERNARD ROMEO (Centre National d'Etudes Spatiales, Toulouse, France) /In CNES, The Management of Large Software Projects in the Space Industry p 383-390 Jun. 1991 In FRENCH Previously announced in IAA as A91-47783

Copyright Avail: CEPADUES-Editions, 111 Rue Nicolas-Vauquelin, 31100 Toulouse, France

Management systems for space project software are discussed. The memorizing, ordering, generating and ensuring aspects of software management are considered. Ways in which to approach the problem of choosing an expert system are outlined. The applicability of the AGILE expert system to typical management situations is demonstrated. The diagnostic aid aspects of the AGILE system seems to be the one most called upon by the users. Use of the system as a memory aid for the various specifications of a space project is seen as another much used aspect of the system. ESA

N92-20927# Rolls-Royce Ltd., Derby (England).

KEYS TO EXCELLENCE IN DESIGN AND MANUFACTURE

P. C. RUFFLES 1 Nov. 1990 15 p Presented at the Aerospace Technology Conference and Exposition, Portsmouth, England, 26-28 Jun. 1990

(PNR-90781; ETN-92-90767) Copyright Avail: CASI HC A03/MF A01

Some of the major issues in achieving excellence in design and manufacture are illustrated. The subject is explored from the initiation of ideas, through to the generation of technological knowledge product validation. The effects on the design and manufacturing process of the new super high reliability required for extended twin engine operations at aircraft entry into service are illustrated as being the next challenge to the aerospace industry. ESA

N92-23929# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

MARKET DIRECTED THINKING IN A TECHNOLOGICAL OPERATION [MARKTORIENTIERTES DENKEN IN EINEM TECHNOLOGIEUNTERNEHMEN]

WALTER KOMANN /In its Symposium on Marketing for Technological Products 3 p 1990 In GERMAN
Avail: CASI HC A01/MF A01

The main themes to be dealt with in the symposium are presented. Market directed thinking is to take a predominant part in all industrial activities, including aircraft navigation, space navigation, and defense technique in particular as defense activities are decreasing. ESA

N92-25785# Kauppa-ja Teollisuusministerio, Helsinki (Finland). Avaruusasian Neuvottelukunta.

TASKS OF THE COUNCIL AND GENERAL SECRETARY OF THE COMMISSION FOR SPACE INDUSTRY (FINLAND) [AVARUUSASIAIN NEUVOTTELUKUNNAN JA PAEASIHTEERIN TEHTAIVAET]

HAAKAN SANDELL /In Oulu Univ., Second Meeting of Finnish Space Researchers p 61-62 1990 In FINNISH
Avail: CASI HC A01/MF A01

The work of the Commission is outlined. The organizational, financial, and administrative distribution of this organization is discussed. The organization is under the control of the ministry of commerce and industry and is regulated by the decree of February 1989. ESA

N92-30957# Air Inter, Lignes Aeriennes Interieures, Paris (France). Centre d'Instruction de Personnel Navigant.

FLIGHT CREW INTEGRATION IN THE MAINTENANCE CHAIN OF A COMMERCIAL AIRCRAFT (A 320) [INTEGRATION DE L'EQUIPAGE DANS LA CHAINE DE MAINTENANCE D'UN AVION COMMERCIAL (A 320)]

C. RAFIN and G. RAFFIN /In CEP Systemes, ILS, CE, CALS? From Design to Operation 9 p 1991 In FRENCH
Avail: CASI HC A02/MF A02

An integration of flight crews and maintenance teams was carried out for the acquisition of an A-320. The characteristics of the aircraft are underlined. Personnel training, meetings, implementation of maintenance and management computer systems were put into practice. Real time computer systems for the management of technical data and an aircraft communication addressing and reporting system were implemented. The following topics are included: the operation of a radio-telephone network and the flight crew technical tasks. The objectives of the company concerning the integration of several different sections and personnel were achieved. The successful operation and safety of the A-320 was reached thanks to the information exchanges between flight crews and ground supporting systems and teams. ESA

N92-33466# Vrije Univ., Brussels (Belgium).

THE USOCs, THE RESOURCES MANAGEMENT, AND THEIR LINKS WITH TELESCIENCE

M. C. LIMBOURG /In ESA, Telescience for Space Experimentation in the Fields of Space Science, Life, Materials and Fluid Sciences and Earth and Environmental Sciences p 59-66 Mar. 1992
Copyright Avail: CASI HC A02/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The in orbit elements of the Columbus Program are the Attached Laboratory, the Free Flying Laboratory, and the Polar Platform. The Attached Laboratory is the European part of the Space Station Freedom. The European participation in the Space Station utilization is 12.8 percent, giving to Europe the same share of the space station resources. The different types of hardware proposed for Columbus are defined as well as the partition of this hardware in national and ESA utilization programs. An example of implementation of the hardware is given. The main differences between Columbus and Spacelab hardware is the modularity and telescience capability. They are imposed by the long duration of utilization. Modularity is required for easy inflight maintenance, servicing, and repair, and telescience is required for continuous operations. The ground infrastructure for Columbus utilization is described: the role of the UHB (User Home Bases), regional USOC (User Support and Operation Centers), and FRC (Facility Responsible Centers) in the telescience operation of the experiments and MUF's (Multi-User Facilities) is outlined. A modular MUF is described with an example of a telescience experiment. The influence of teleoperation on resource utilization is discussed. ESA

N92-33686# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Stabsbereich Oeffentlichkeitsarbeit.

MBB DEUTSCHE AEROSPACE FINANCIAL YEAR Annual Report, 1990 [MBB DEUTSCHE AEROSPACE: DAS GESCHAEFTSJAHR 1990]

May 1991 42 p In GERMAN
(ETN-92-91908) Avail: CASI HC A03/MF A01

Subjects covered were: economic situation, business progress, employment, research and development, investments, and results. The various fields of activity in helicopters, rail vehicles, aircraft, aerospace, military equipment, energy, new technologies, are described. During the financial year 1990, MBB was incorporated in the German Aerospace company DASA, whose majority participation in MBB was raised to 70 percent. ESA

DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

A92-44994**THE DEVELOPMENT OF AN INTELLIGENT HUMAN FACTORS DATA BASE AS AN AID FOR THE INVESTIGATION OF AIRCRAFT ACCIDENTS**

AMANDA J. W. FEGGETTER (Ministry of Defence, London, England) IN: International Symposium on Aviation Psychology, 6th, Columbus, OH, Apr. 29-May 2, 1991, Proceedings. Vol. 2. Columbus, OH, Ohio State University, 1991, p. 624-629. refs

A human factors data aid encompassing psychological, physiological, sociological, and ergonomic considerations has been developed for use in the investigation of aircraft accidents. This data base incorporates intelligence in the form of stored rules and prior knowledge, collectively constituting a comprehensive list of contributory factors; after covering a given incident in detail, the aid allows all relevant data to be organized in the form of a draft standardized report. The system also facilitates the reexamination of suspected causative factors. O.C.

A92-55758**AN ATTEMPT TO UNIFY SPACE TERMINOLOGY - THE MULTILINGUAL TERMINOLOGY DATA BASE**

I. ALMAR (Konkoly Observatory, Budapest, Hungary) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 5 p. refs
(IAF PAPER 92-0343) Copyright

The development of the Multilingual Terminology Data Base (MTDB) as part of a program undertaken by the International Academy of Astronauts in an effort to unify space terminology is reported. The final basic list of the MTDB contains 2596 terms. A critical comparison with other dictionaries, however, indicates that the different branches of astronautics are not equally well represented. The historical background of the program, the MTDB content, and suggestions for further improvements are discussed. V.L.

A92-55761**HOW TO CIRCULATE OFFICIAL TERMINOLOGY**

OLEG LAVROFF (AAAF, Paris, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p.
(IAF PAPER 92-0346) Copyright

The advantages and drawbacks of various possible approaches to the problem of how to effectively circulate official aerospace terminology, such as the automatic generation of a glossary or application to computer-aided translation, or the distribution of specialized dictionaries on paper, are addressed. The implementation of a system of organization, assuming rapid and continuous growth of this official terminology, is suggested, and the necessary circulation is estimated. P.D.

A92-55762**ACTIVITIES RELATING TO SPACE TERMINOLOGY IN FRANCE**

J.-L. ASTOR (CNES, Departement Publications, Toulouse, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p.
(IAF PAPER 92-0348) Copyright

An effort by the International Council for the French Language to enhance the French vocabulary of aerospace terms is reviewed. The program resulted in publishing in 1978 of the Dictionary of Space Science and Technology containing definitions of a thousand terms and expressions for use in the field of space technology, along with their English and German equivalents. The dictionary was later expanded to 1600 terms, with translations including Spanish and Russian languages in addition to French and German.

The new edition of the dictionary, which is currently being prepared, will contain 2300 French terms and their equivalents in English, German, Spanish, Russian, and Italian. V.L.

A92-55764**TOWARDS AN ELECTRONIC DICTIONARY OF THE SPACE TECHNICAL DOMAIN**

M. BRAS, A. CONDAMINES, Y. TOUSSAINT, A. SIMON (Matra Marconi Space, Toulouse, France), and M. BORILLO (CNRS, Toulouse, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 11 p. refs
(IAF PAPER 92-0354) Copyright

The linguistic data - morphological, syntactic and semantic - and the terminological data constituting a possible electronic dictionary of space are described. The relations that exist between the Dictionary of Linguistic Engineering for Software Development, which is the dictionary of a technical sublanguage, and the dictionary of the general language are addressed. The terminological data base plays the role of a pivot between the language model and the domain model. P.D.

A92-55766**SOME NEW DEFINITIONS FOR THE MULTILINGUAL TERMINOLOGY DATA BASE**

I. ALMAR (Konkoly Observatory, Budapest, Hungary) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p. refs
(IAF PAPER 92-0359) Copyright

Short definitions are presented for some aerospace terms taken from the English-Hungarian version of the Basic List of the Multilingual Terminology Data Base. In particular, definitions are presented for some terms with different meanings in different branches of astronautics (e.g., apex, baseline, grounding, range), interrelated terms (e.g., moon, satellite, background radiation), and some neologisms (e.g., targeted search, all-sky search, water hole). V.L.

A92-55773**SPACE TERMINOLOGY - THE CASE FOR A COMMON LANGUAGE**

MARK WILLIAMSON IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 12 p. refs
(IAF PAPER 92-0368) Copyright

The importance of developing an internationally agreed-upon dictionary of space-related terminology as an aid to international cooperation and mutual understanding in space exploration is demonstrated. It is suggested that the adoption of English as the common language of space may be a more efficient route to global understanding of space technology than the multilingual approach. It is proposed that such a dictionary be compiled in English and then translated into other languages as required. Some guidelines for the compilation of the dictionary are presented. V.L.

N92-18659# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Technical Information Panel.

INTELLECTUAL PROPERTY RIGHTS

Oct. 1991 235 p In ENGLISH and FRENCH Lecture series held in London, England, 21-22 Oct. 1991, in Brussels, Belgium, 24-25 Oct. 1991, and in Arlington, VA, 6-7 Nov. 1991 (AGARD-LS-181; ISBN-92-835-0639-1; AD-A246281) Copyright
Avail: CASI HC A11/MF A03

Intellectual property has become one of the keys to the management of high technology sectors and communication systems. The concept is, however, used to describe a variety of different situations influenced by the combined effect of technical and economic change. From this results an intensive legal activity, not only in the passing of new legislation and the creation of jurisprudence, but also in the field of contractual and professional practice, which is becoming more important. The aim of this Lecture Series is therefore to provide a few markers, to look at the

prospects for these trends and to assess the stakes involved, so as to enable better evaluation and control of national and international legal practices.

N92-18661# Defence Research Agency, London (England). Intellectual Property Dept.

SECTOR BASED LOGIC AND PRACTICE OF INTERNATIONAL COMPANIES IN THE FIELDS OF DATA MANAGEMENT AND TECHNOLOGY TRANSFER

ROBERT W. BECKHAM /in AGARD, Intellectual Property Rights 5 p Oct. 1991

Copyright Avail: CASI HC A01/MF A03

In considering data management and technology transfer, it is found that different areas of industry and other organizations operating in technological fields have developed policies which best reflect the environment, both legal and national, in which they operate. Furthermore, attitudes of individual companies are colored by the attitudes of immediate competitors. In this talk, consideration will be given to the effectiveness of legal protection mechanisms in various parts of the world. It should be particularly noted that legal mechanisms specifically intended to promote technology transfers, particularly systems of compulsory licensing, often have the opposite effects, restricting both the availability of information and technology transfer. Author

N92-18665# Controle General des Armees, Paris (France).

TRANSFERS OF TECHNOLOGY: INTERNATIONAL NEGOTIATIONS AND WORK IN PROGRESS

PAUL FREIERMUTH /in AGARD, Intellectual Property Rights 8 p Oct. 1991

Copyright Avail: CASI HC A02/MF A03

Areas of discussion which were presented at the COCOM meeting held in Paris on 23 and 24 May, 1991 are examined. The conferences were cognizant of the problems inherent in technology transfer. The meeting highlighted the government's problem of how to define a simple set of lines of conduct relating to technology for government (military) use. The three main topical areas of discussion are as follow: the end use of transfers of technology are many and varied, often falling into a political context of industrial strategy and appropriate legal instruments are used to implement them; how transfers of technology can take a variety of forms such as sale and as cooperation agreements; and how the obstacles have cultural, economic, technical, or political connotations. E.R.

N92-25787# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.

SPACE ELECTRONIC DISPLAY PANEL (AVARUUSALAN ELEKTRONINEN ILMOITUSTAUHU)

TERO SIILI /in Oulu Univ., Second Meeting of Finnish Space Researchers p 65-66 1990 In FINNISH
Avail: CASI HC A01/MF A01

The AVAR-EI, which is a 'space electronic display panel', is discussed in terms of its engineering. The display panel was designed under the guidance of the Finnish Institute of Meteorology. ESA

N92-71169 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Planning Div.

LIST OF REPORTS, 1989 Abstracts Only

W. WILKE Jul. 1990 38 p

(ISSN 0171-6239)

Avail: CASI HC A03

The output of aerospace and aeronautics report literature for the Planning Division of the Deutsche Forschungsanstalt fuer Luft- und Raumfahrt is presented with English abstracts for the year 1989. The listings are arranged by report number and they are indexed by author and corporate source. Many reports are in English. R.L.B.

N92-71170 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abteilung Operative Uternehmensplanung.

LIST OF REPORTS, 1990 Abstracts Only

W. WILKE Sep. 1991 39 p

(ISSN 0939-2998)

Avail: CASI HC A03

The output of aerospace and aeronautics report literature for the Deutsche Forschungsanstalt fuer Luft- und Raumfahrt Planning Division is presented with English abstracts for the year 1990. The listings are arranged by report number and they are indexed by author and corporate source. Many reports are in English. R.L.B.

83

ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

A92-20516

INSURANCE TURNS THE CORNER

STEPHANE CHENARD Interavia Space Markets (ISSN 0258-4212), vol. 7, no. 5, 1991, p. 22-24, 26.

Copyright

The current international situation regarding launch and other insurances is reviewed with attention given to multilaunch insurance packages, diminishing premium rates, and the impact of self-insurance. The advanced size and complexity of recent satellite launches is set forth as a significant rate driver, and additional areas of insurance coverage are noted including transponders and political risk. Industrywide capacity for liability coverage is shown to be dwindling due to claims relating to toxic waste dumps and asbestos-induced liabilities. Mergers between major insurers are restructuring and limiting the market, and self-insurance is becoming a preferred method for some aerospace entities. Several methods are listed for reducing premium costs including adjustments according to reliability record and the strategy of in-orbit procurement. C.C.S.

A92-20591

ORGANIZATIONAL IMPEDIMENTS TO THE REDUCTION OF COSTS OF SPACE PROGRAMMES

R. C. PARKINSON (British Aerospace /Space and Communications/, Ltd., Stevenage, England) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs

(IAF PAPER 91-639) Copyright

Spaceflight is very expensive, and after 30 years of sustained activity cannot be considered mature technology. The principal impediment to cost reduction may be organizational. There is evidence that the expectation that space program costs will be large, and require government support, leads to expensive space program. Disasters such as the loss of Challenger or flaws in Hubble are major because of the huge investment in the system. Low cost systems would be replaced more readily, and would evolve more rapidly due to accumulated experience. Organizational practices include advancing technology where available technology could be used. Cooperative squabbles about technology return, micromanagement, inflexibility in design decisions and discouragement of innovation. The per kilogram cost of space hardware should be similar to the cost of launch - indicating, for low earth orbit hardware, costs of about \$5000-\$10,000/kg rather than the current \$100,000/kg. The paper provides analysis and examples, and suggests the key organizational factors which may have to be changed to improve the situation. Author

A92-22725

REDUCING RISKS

TIM FURNISS Flight International (ISSN 0015-3710), vol. 141, Jan. 22, 1992, p. 43-45.

Copyright

A review is presented of the necessity for satellite operators to implement comprehensive risk-management programs and for

underwriters to find means of rewarding operators with proven track records that institute such programs to reduce the loss resulting from a satellite failure or launch vehicle explosion. Insurance rates could have been expected to exceed 20 percent throughout the 1990s had the insurance market not shown a modest premium increase, coupled with a firmer request by space underwriters for more prompt and detailed technical information about the risks to cover. Fewer losses, lower prices, and higher profits would result if a way was found to provide incentives and reward those buyers who are willing to invest in the top technical expertise with the highest quality control. R.E.P.

A92-35474**INSURERS LOSE FROM HIGH-RISK DEALS**

IAN VERCHERE Interavia Aerospace Review (ISSN 0020-6512), vol. 47, April 1992, p. 45-47. Copyright

A report is presented of how aviation insurance is plagued by an unhealthy imbalance between the premiums generated from its client firms and the amount paid out on their claims. The current hull-loss trend indicates a doubling every 10 years, suggesting average hull claims of one billion dollars by the year 2000. The passenger liability side of aviation insurance remains an equally large portion of the underwriting risk, which may reach the two billion dollar mark by the end of the decade. R.E.P.

A92-53777**THE INTOSPACE MARKET DEVELOPMENT STRATEGY AND THE SCENARIO OF PROVIDED MICROGRAVITY, AND LAUNCH SYSTEMS**

J. K. VON DER LIPPE (Intospace GmbH, Hanover, Germany) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2293-2299. Copyright

A Market-Development Program which responds to the requirements of industrial users of microgravity devices has been developed. An account is presently given of the scenario of facilities for microgravity research thus supported. The facilities encompass a drop tower, a drop shaft, parabolic flights, a drop capsule, a sounding rocket system, the Photon reentry system, Spacelab, the Spacelab commercial manned system, and the Eureka free-flying platform. O.C.

A92-55635**AN ECONOMIC BENEFIT DERIVING FROM SPACE ACTIVITIES - INTEGRATION BETWEEN SCIENCE INSTITUTIONS AND INDUSTRY**

R. MONTI, M. D'AMORE, and L. D'ANGELO (Microgravity Advanced Research and Support Centre, Naples, Italy) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs (IAF PAPER 92-0177) Copyright

An overview is presented of the debate taking place in Italy on the assessment of the economic benefits deriving from the national expenditure in space programs. Specific studies on this issue have recently been undertaken by the Italian Space Agency. This report attempts to provide an original insight into this debate by concentrating on the often underestimated effect that the development of space programs has on the process of integration of universities, research centers, and industry. R.E.P.

N92-21851# Rolls-Royce Ltd., Derby (England).**EC FUNDING OF COLLABORATIVE RESEARCH PROJECTS**

H. C. HILLIER 1 Nov. 1990 20 p (PNR-90833; ETN-92-90789) Copyright Avail: CASI HC A03/MF A01

Some of the benefits and opportunities of participating in EC (European Community) research and technology programs, as well as some of the constraints, are looked into. In order to understand the motives and the mechanisms associated with EC research funding, the history of research and technology in the EC is briefly reviewed. This leads naturally to the concept of framework

programs, the setting of the overall strategy and the consequent determination of priorities. Some examples of the current research and technology programs relating to heat engines are given. The status of the current EC research action in aeronautics is reviewed. ESA

84

LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

A92-11215**REGISTRATION OF AIRCRAFT IN THE AIRCRAFT REGISTRAR USING THE 'LEASING DECREE' OF THE FEDERAL MINISTER OF TRANSPORT OF FEBRUARY 12, 1991 [DIE REGISTRIERUNG VON LUFTFAHRZEUGEN IN DER LUFTFAHRZEUGROLLE NACH DEM 'LEASINGERLASS' DES BUNDESMINISTERS FUER VERKEHR VON 12. FEBRUAR 1991]**

THOMAS WENZLER Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 40, Sept. 1991, p. 276, 277. In German. refs Copyright

The law covering registration of aircraft in Germany is briefly reviewed. Attention is given to the procedure for registering leased aircraft. C.D.

A92-16134**LEGAL CAPACITY OF EUROCONTROL TO ENSURE SMOOTH AVIATION IN EUROPE**

A. A. MAJID (City of London Polytechnic, England) Air Law (ISSN 0165-2079), vol. 16, Dec. 1991, p. 267-279. refs Copyright

The problem of organizing European airspace is examined in terms of the causes of the problem, remedial steps that have been taken, the use and extent of Eurocontrol, and a proposed functional solution. Lack of coordination in the fragmented European atc system is identified as the major obstacle to the efficient use of airspace. Early remedial action included a directive for close collaboration and the development of a Europe-wide switching center based in London for 4D atc services. Eurocontrol (the proposed European Organization for the Safety of Air Navigation) is introduced, and the role of the organization is to provide analysis of atc needs, development of air-navigation plans, and promotion of common policies and research. The functional solution for Eurocontrol expands the operational functions of the organization and permits wider powers in planning and coordination to stem waste and promote safer airspace. C.C.S.

A92-20515**TWILIGHT OF THE MACHINE BUILDERS**

STEPHANE CHENARD Interavia Space Markets (ISSN 0258-4212), vol. 7, no. 5, 1991, p. 11-15, 18, 19. Copyright

The paper describes the current state of the space programs and activities of the former Soviet Union emphasizing the present competition between republics for bureaucratic control. The republics of Ukraine, Moldavia, and Georgia have sovereignty over civilian space infrastructures in their respective territories although utilization is coordinated by a central body. The existing command structure is preserved by an agreement between the republics until revised institutions are accepted such as a regional organization. The former Soviet Ministry of Machine-Building is being dismantled with the aim of developing smaller independent units for the manufacturing base. Concerns over decision routes being bypassed are described, and the budget is characterized as

providing for some development the Martian program alone.
C.C.S.

A92-33048**EUROCONTROL - UK DETENTION RIGHTS**

TOM CHRISTOPHERSON and JAN-HEIN BAX Air & Space Law (ISSN 0165-2079), vol. 17, Feb. 1992, p. 2-8. refs
Copyright

A review is presented of the background, functions, and powers of Eurocontrol and recent attempts to challenge UK detention powers in respect of Eurocontrol charges are examined. The European Commission has indicated that it would prefer to see the ATC system of each member State joined into a single computerized system for Western Europe, under Eurocontrol's control and direction. To achieve this end a wide ranging review of Eurocontrol's sources of funding and general structure will be necessary.
R.E.P.

A92-35587**SELECTED PITFALLS AND BOOBY-TRAPS IN AIRCRAFT FINANCE**

BEREND J. H. CRANS (De Brauw Blackstone Westbroek, Amsterdam, Netherlands) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 43-52. refs
Copyright

Issues which are likely to arise in any aircraft finance transaction are discussed and a solution or alternative that could be helpful is offered. Attention is given to the Geneva Convention on the International Recognition of Rights in Aircraft, emphasizing its two major shortcomings: the limited geographical scope and the lack of uniform interpretation. Consideration is given to the problems of engine interchangeability, true lease problems, the assignment of claims under lease/sublease agreements, and third party rights.
R.E.P.

A92-35588**TAX ASPECTS OF AIRCRAFT LEASING IN THE NETHERLANDS**

DICK HOFLAND Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 53-60.
Copyright

A report is presented on how the Netherlands has built a reputation as a financial center for a wide range of aircraft financial transactions. Netherlands finance, holding, and licensing companies play an important part in international finance, including the field of aircraft leasing. The various tax implications of aircraft leasing transactions in which Netherlands parties are involved are described. Some general principles of Netherlands corporate income tax, value added tax, and dividend withholding tax are discussed.
R.E.P.

A92-35589**SECURITY RIGHTS IN AIRCRAFT UNDER BELGIAN LAW**

WILFRED GORIS and GREGOIRE JAKHIAN (De Bandt, Van Hecke & Lagae, Brussels, Belgium) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 61-67.
Copyright

The rules of Belgian law covering the registration and nationality of aircraft are described. The general issues of conflict of laws are addressed and the various techniques available to create a security interest in or related to engines or aircraft are presented. Attention is given to private and national aircraft, legal status, registration and nationality, the techniques used to create a security interest in engines or aircraft, and the pledging of aircraft and engines.
R.E.P.

A92-35591**CONFLICT OF LAWS IN THE AIR - SOME LEGAL ISSUES OF INTERNATIONAL AIRCRAFT FINANCING AND LEASING**

MAURICE V. POLAK (Brabant, Catholic University, Tilburg; De Brauw Blackstone Westbroek, The Hague, Netherlands) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 78-86.

refs

Copyright

In the Netherlands, neither the contractual aspects of international aircraft financing and leasing nor the property law aspects of security interests in aircraft seem to have been the subject of litigation or attracted any attention from conflict of laws scholars. Three conflict of laws issues are addressed that are relevant both at the stage of negotiating and drafting contracts, and at the stage of litigation. Attention is given to the law applicable to the contractual issues, the creation and the recognition of security rights, and dispute resolution and the enforcement of judgments.
R.E.P.

A92-35592**HIGHLIGHTING VARIOUS TAX AND SECURITY LAW ASPECTS OF AIRCRAFT FINANCING - FRANCE**

JEAN-PIERRE LE GALL (Jeantet & Associates, Paris, France) and SONIA REEB (Jeantet & Associates, London, England) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 87-91.
Copyright

Various aspects of French security law and tax aspects from the bank standpoint, relevant to aircraft financing, are presented. Attention is focused on the modes of financing where a bank loan is arranged for the direct purchase of the aircraft by the airline, or the leasing of the aircraft by a bank (or a consortium of banks) to the airline. For both of these cases consideration is given to formal requirements, property charged, determination of the debt secured, and tax aspects.
R.E.P.

A92-35593**AIRCRAFT FINANCING IN SPAIN**

FELIX L. ANTON and JUAN F. FALCON RAVELO (Uria & Menendez, Madrid, Spain) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 104-110.
Copyright

Various aspects of the laws and regulations pertaining to aircraft financing in Spain are reviewed. Economic features of the Spanish aircraft market including the registration of aircraft, the features of a finance and/or operational lease, and the assignment of lease-rentals to owner/financier are discussed. Some of the tax aspects presented include the treatment of an aircraft under Spanish tax law, depreciation and residual value treatment, and rental payments.
R.E.P.

A92-35594**DUTCH SECURITY RIGHTS IN AIRCRAFT AND ENGINES**

TOM I. M. VAN MIERLO Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 111-117. refs
Copyright

The New Civil Code enacted by the government of the Netherlands in January 1992 is presented with particular attention given to the security rights in aircraft and engines within this law. Attention is given to the various types of security rights, the right of pledge on an unregistered aircraft, and the right of pledge on claims under the lease agreement. Consideration is given to the right of mortgage on a registered aircraft, and foreclosure by sale after the mortgagor's default.
R.E.P.

A92-35595**THE ROLE OF THE NOTARY UNDER THE LAWS OF THE NETHERLANDS - WITH RESPECT TO THE TRANSFER OF TITLE AND ENCUMBRANCE OF REGISTERED AIRCRAFT**

RENE W. CLUMPKENS (De Brauw Blackstone Westbroek, Amsterdam, Netherlands) Air & Space Law (ISSN 0927-3379), vol. 17, no. 2, April 1992, p. 118-124.
Copyright

A notary in the Netherlands is a lawyer appointed by the Crown of the Netherlands to serve as a public official within a specified court district. The duties and services of the notary are described (as opposed to an attorney), and it is noted that a notary is not qualified to engage in litigation. Attention is given to the status and form of a notarial deed which has been drawn up and executed in accordance with the law and qualifies as authentic. Consideration

is given to the registered aircraft act, the closing procedure, and legal opinion to the extent that it concerns the conveyance of title to the aircraft and the creation of a right of mortgage.

R.E.P.

A92-36682

CONVERGENCE OF TELECOMMUNICATION TECHNOLOGIES - SOME LEGAL ASPECTS

MAHULENA HOSKOVA (Czechoslovak Academy of Sciences, Institute of State and Law, Prague, Czechoslovakia; Max-Planck-Institut fuer auslaendisches oeffentliches Recht und Voelkerrecht, Heidelberg, Federal Republic of Germany) IN: Colloquium on the Law of Outer Space, 33rd, Dresden, Federal Republic of Germany, Oct. 6-12, 1990, Proceedings. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 215-223. Research supported by Alexander von Humboldt-Stiftung. refs

Copyright

Technological development made the world of the space communication services more convergent. Our aim is to show how this fact influences the application of legal rules governing the international regime of space communication. The first area in which consequences of this development are most remarkable, is the rules which govern the regime of direct broadcasting and fixed satellite services. Together with technological progress, the question of the contents of 'freedom of information' rules as a part of human rights also arise. The legal development in the field of space communication goes together with technical development which creates more opened regime of international transmission of information.

Author

A92-36695

SPACE LAW AND SPACE TECHNOLOGY - A COMMON LANGUAGE

MARK WILLIAMSON IN: Colloquium on the Law of Outer Space, 33rd, Dresden, Federal Republic of Germany, Oct. 6-12, 1990, Proceedings. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 379-387. refs

Copyright

A framework is developed for defining basic concepts related to aerospace technology that can be expanded to include future terms, and attention is given to the interaction between space lawyers and space technologists. The relationships between spacecraft categories, trajectories, and applications are discussed, and spacecraft subsystem technologies are examined. The technologist's role in legal debate is illustrated with the example of developing solutions for the problem of space debris. The technologist is required for interaction with lawmakers to develop a common language for international discussion of aerospace issues. Definitions of important space concepts are presented to illustrate the value of greater interaction between lawyers and technologists, and the framework for a common language is developed by examining common terms that describe spacecraft hardware and orbits.

C.C.S.

A92-38793

THE UK PARLIAMENTARY SPACE COMMITTEE - THE EMERGENCE OF A SPACE LOBBY?

MARK WILLIAMSON Space Policy (ISSN 0265-9646), vol. 8, no. 2, May 1992, p. 159-165.

Copyright

The development of the UK Parliamentary Space Committee (PSC) is described with references to key events related to European space policy. The objectives of the PSC include the maintenance of the UK's technology base, the encouragement of national and ESA programs, and the development of a market-oriented approach to space. The paper examines the relevance and utility of space technologies, European collaboration on large projects, and the role of the European Community in space affairs. The PSC is shown to be an active asset for industrial and economic growth in the UK because it has the influence and knowledge required to promote the political, economic, and technological rewards of space exploration. It is concluded that

an active UK space lobby is needed to challenge the governments' space policies and influence international directions in space development.

C.C.S.

A92-43548

JOINT AVIATION AUTHORITIES: DEVELOPMENT OF AN INTERNATIONAL STANDARD FOR SAFETY REGULATION - THE FIRST STEPS ARE BEING TAKEN BY THE JAA

NICOLA ARRIGONI Air & Space Law (ISSN 0927-3379), vol. 17, no. 3, June 1992, p. 130-132.

Copyright

An overview is presented of the Joint Aviation Authorities (JAA), an organization of 19 European countries set up originally to establish joint certification requirements for the approval of aircraft design. JAA's work has broadened to include operations, airworthiness, noise, and flight crew licensing and certification.

R.E.P.

A92-43549

CAAC GUANGZHOU HI-JACKING - INSURANCE ISSUES

JONATHAN BARRETT and MICHAEL PILKINGTON Air & Space Law (ISSN 0927-3379), vol. 17, no. 3, June 1992, p. 133-136.

Copyright

A review is presented of the accident that occurred in 1990 when a hi-jacked Chinese 737 collided with two other aircraft on landing at Guangzhou. Attention is focused on the question of levels of compensation payable to passengers in China and what policies would apply to the two aircraft damaged on the ground. Consideration is given to the arguments presented and the decisions rendered in the arbitration that took place in London.

R.E.P.

A92-43550

EUROCONTROL AND AIRPORT LIENS AND SOME OTHER RIGHTS OF DETENTION/FORFEITURE OF AIRCRAFT

NICHOLAS HUGHES (Barlow Lyde & Gilbert, London, England) Air & Space Law (ISSN 0927-3379), vol. 17, no. 3, June 1992, p. 137-146. refs

Copyright

The owner/lessor of an aircraft is faced with considerable uncertainty and risk both in purchasing used aircraft and in parting with possession to lessees/mortgagees due to the many claims that may be enforced against the aircraft in priority to the ownership rights. Since insurance coverage may not be available the owner's risk is the creditworthiness of the lessee for the amounts involved. This paper examines the situation under English law where some of the problems for the owner/lessor are most acute and makes comparisons with a number of other jurisdictions.

R.E.P.

A92-49454

BASIC CONSIDERATIONS IN DEVELOPMENT COOPERATION - THE APPLICATION OF REMOTE SENSING IN DEVELOPING AND NEWLY INDUSTRIALIZED COUNTRIES

K. I. ITTEN (Zuerich, Universitaet, Zurich, Switzerland), C. N. SPECTER (Florida International University, Miami), and T. M. SAUSEN (INPE, Sao Jose dos Campos, Brazil) ISPRS Journal of Photogrammetry and Remote Sensing (ISSN 0924-2716), vol. 47, no. 4, June 1992, p. 325-332. refs

Copyright

Basic requirements and factors which are of prime concern in remote sensing development cooperation in terms of policy, application, and implementation are analyzed. Emphasis is placed on problems of scale, accuracy, timeliness, and cost. It is concluded that successful technology applications must be based on true cooperation between local and expatriate experts.

O.G.

A92-51854

'SPACE OBJECTS', 'ASTRONAUTS', AND RELATED EXPRESSIONS

BIN CHENG (London, University, United Kingdom) IN: Colloquium on the Law of Outer Space, 34th, Montreal, Canada, Oct. 5-11, 1991, Proceedings. Washington, American Institute of Aeronautics

and Astronautics, 1992, p. 17-27. refs
Copyright

Due partly to the speed of development of astronautics and partly due to a lack of coordination, some of the terms used in outer space treaties are increasingly being seen as confusing or inadequate. These terms include 'space objects', 'astronauts', and related expressions such as 'personnel of spacecraft'. This paper attempts to unravel the meaning of these terms in international space law, especially in the context of several treaties developed by the United Nations and relating to outer space. C.D.

A92-51856

ISSUES INVOLVED IN DEFINING OUTER SPACE, SPACE OBJECT AND SPACE DEBRIS

VLADIMIR KOPAL (Charles University, Prague, Czechoslovakia)
IN: Colloquium on the Law of Outer Space, 34th, Montreal, Canada, Oct. 5-11, 1991, Proceedings. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 38-44. refs
Copyright

Criteria for developing legal definitions of outer space, space object, and space debris are discussed. Changes that may need to be made in present outer space law are considered. C.D.

A92-51870

SPACE DEBRIS - A PROPOSAL FOR ITS INTERNATIONAL LEGAL REGULATION

STEPHAN HOBE (DARA GbmH, Bonn, Germany) IN: Colloquium on the Law of Outer Space, 34th, Montreal, Canada, Oct. 5-11, 1991, Proceedings. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 194-200. refs
Copyright

The paper presents the outline of a draft legal instrument for the problem of space debris. First, a short survey of the factual situation is given, identifying space debris as one of the greatest actual threats to the usability of outer space. Next, the legal regulation of this problem by existing international treaty and customary law will be considered. Based on this investigation, the question is addressed as to whether a new legal instrument is needed at all and, in case of a positive answer, what legal quality this instrument should have. Author

A92-57353

SPACE DEVELOPMENT SCENARIOS - A NEW FRAMEWORK FOR EVALUATION

PHILIP GOYAL (Oxford, University, United Kingdom) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs
(IAF PAPER ST-92-0002) Copyright

A summary of a model of space development, i.e., exploitation and exploration, is presented. Key trends, such as changing political perceptions of space development are identified, and their possible impact on the future of space development is described. It is concluded that the likely dominance of commercial interests in space exploration, coupled with other subsidiary political concerns, will ensure continued space exploration and increased feasibility of manned space exploration. Author

85

URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

A92-55636

AN EXAMPLE OF SPACE TECHNOLOGICAL TRANSFER IN A SMALL COUNTRY

M. M. GOGOSHEV (Bulgarian Academy of Sciences, Dept. of Astronomy; National Astronomical Observatory, Stara Zagora,

Bulgaria) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs
(IAF PAPER 92-0178) Copyright

A short history of the space activity in Bulgaria and some examples of the connected transfer of space technologies to the industry are presented. The design and construction of some national standards (in optical photometry and magnetic measurements) as a spin off from space activity are described. Different industrial computerized automatically working systems were constructed by using space high technologies. A meteorological multisensors system for road conditions monitoring and prediction, constructed by using the 'satellite example' is also described. The most significant benefit from the space activity is the education of high-tech engineers, constructors, designers and other specialists. Author

N92-15938#

Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Dienstleistungsbereich.

THE ACOUSTIC FLASHLIGHT [DIE AKUSTISCHE TASCHENLAMPE]

STEPHAN BRUEHL 1990 6 p In GERMAN Original contains color illustrations
(MBB-Z-0359-90-PUB; REPT-3/1990; ETN-92-90610) Avail:
CASI HC A02/MF A01

It is shown that for traveling speeds over three hundred kilometers per hour, sound radiation is determined by aerodynamical effects, e.g., by local shedding of vortices and large area boundary layer noise. In order to obtain exact information on the position and strength of these aerodynamic sources of sound on vehicle surfaces, a measurement process aiming at localizing and analyzing quantitatively quick moving sources of sound was developed. The measuring equipment is described, e.g., a directional microphone which is placed at about five meters off the roadway. Using light cabinets, the vehicle position can be exactly determined, with regard to the measuring station at any overhaul time. ESA

88

SPACE SCIENCES (GENERAL)

A92-57345

SETI IN FRANCE

FRANCOIS BIRAUD (Meudon, Observatory, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 3 p.
(IAF PAPER 92-1023) Copyright

A historical overview of the development of SETI research in France is presented. Attention is given to the investigations conducted at the Meudon Observatory and what is envisaged for future participation with other countries in this work. R.E.P.

N92-25758# Oulu Univ. (Finland). Dept. of Physics.

SECOND MEETING OF FINNISH SPACE RESEARCHERS [2. SUOMEN AVARUUSTUTKIJOIDEN KOKOUS]

PEKKA TANSKANEN, comp. and JOUKO RAITALA, comp. 1990 77 p In ENGLISH and FINNISH Meeting held in Oulu, Finland, 5-6 Oct. 1989
(ISSN 0356-1852)
(REPT-117(1990); ISBN-951-42-2903-7; ETN-91-99900) Avail:
CASI HC A05/MF A01

The activities of the Finnish space science and technology community are reviewed. Finnish participation in space programs including spacecraft and ground instrumentation is covered. Societies, industries, universities, and organizations involved in space sciences and the Finnish Air Museum are mentioned. ESA

N92-25761# Suomen Ilmailumuseo, Vantaa (Finland).

AIR MUSEUM [SUOMEN ILMAILUMUSEO]

BOERJE HIELM *In* Oulu Univ., Second Meeting of Finnish Space Researchers p 6 1990 In FINNISH
Avail: CASI HC A01/MF A01

Aspects of the air museum at Vantaa (Finland) are described. The second exhibition hall was inaugurated in 1989 and houses a permanent space activity exhibition. ESA

N92-25762# Suomen Ilmailumuseo, Vantaa (Finland).

SOCIETY OF SPACE STUDIES Abstract Only [SUOMEN AVARUUSTUTKIMUSSEURA]

BOERJE HIELM *In* Oulu Univ., Second Meeting of Finnish Space Researchers p 7 1990 In FINNISH
Avail: CASI HC A01/MF A01

The society, which has functioned since 1959 as a liaison between professionals and amateurs in the space sciences field, and with other similar foreign societies, is described. Its objective is to promote space sciences amongst members and the public at large. ESA

89

ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy; and astrometry.

A92-18593

ON THE RADIANT DETERMINATION OF METEORS

P. PECINA (Czechoslovak Academy of Sciences, Astronomical Institute, Ondrejov, Czechoslovakia) Astronomical Institutes of Czechoslovakia, Bulletin (ISSN 0004-6248), vol. 42, no. 5, Oct. 1991, p. 307-316. refs
Copyright

The derivation of the formulas yielding the meteoroid velocity vector is described. The equation of motion is proposed which takes into account simultaneously both the drag and the gravitational force from the observed heights to the standard reference level of 150 km. It is demonstrated how the final results can be affected by the use of a particular method of fitting the data. All findings are visualized by the results of processing selected fireball data observed in the European network. It is found that the differences between classical results and the method under consideration are not enormous, but are outside the standard deviation boxes. The procedure based on numerical integration of the equation of motion is recommended as the method for obtaining a valid velocity vector. O.G.

N92-25782# Helsinki Univ. of Technology, Espoo (Finland). Radiolab.

MILLIMETER WAVE TECHNOLOGY IN SPACE

[MILLIMETRIAL TOTEKNIKKAA AVARUUTEEN]

ANTTI RAEISAENEN *In* Oulu Univ., Second Meeting of Finnish Space Researchers p 53-54 1990 In FINNISH
Avail: CASI HC A01/MF A01

The development and study of millimeter wave technology for space applications (in ESA projects) is discussed. Examples of Finnish and Soviet cooperation, in the area of space studies, are presented. Particular projects include: development of critical detection technologies for spaceborne submillimeter heterodyne receivers; and Finnish participation in equipment destined for the Soviet satellite Radioastron. ESA

N92-27049 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany). Inst. fuer Extraterrestrische Physik.

THE HUS SOLAR FLARE AND COSMIC GAMMA RAY BURST DETECTOR ABOARD THE ULYSSES SPACECRAFT

MICHEL BOER (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany, F.R.)), MICHAEL SOMMER (Max-Planck-Inst.

fuer Extraterrestrische Physik, Garching (Germany, F.R.)), and K. HURLEY (California Univ., Berkeley.) Feb. 1990 15 p Previously announced in IAA as A91-14631 Submitted for publication (MPE-PREPRINT-175; ETN-92-98599) Avail: Fachinformationszentrum Karlsruhe, 7514 Leopoldshafen-Eggenstein 2, Fed. Republic of Germany

An overview of the instruments and scientific objectives is given of the HUS experiment aboard the ESA-NASA Ulysses spacecraft. The primary objective is the detection of cosmic gamma ray bursts and solar hard x ray flares. Details of the Si sensors and CsI detectors used in the experiment are given as well as their position aboard the spacecraft and details of the journey being made. The impulsive energy release, the heating and particle acceleration, the storage, and the energy transport of solar flares will be observed using multispacecraft and multiwavelength observations. Partial distribution and classification of the sources of gamma ray bursts are examined as well as soft gamma ray repeaters and the Jovian hard x ray emission. Author

90

ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

A92-13865

NEUTRON SUPERFLUID SPIN-DOWN AND MAGNETIC FIELD DECAY IN PULSARS

P. B. JONES (Oxford, University, England) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 253, Nov. 15, 1991, p. 279-286. refs
Copyright

The problem of magnetic flux expulsion from the superconducting interior of a neutron star is reexamined under the assumption that superfluid neutron vortices interact strongly with the two-dimensional lattice of proton vortices. The response of the proton-electron system to a Magnus force acting on the neutron vortices is found. An approximate upper limit is obtained for the Magnus force which would move a neutron vortex through the proton vortex lattice. Magnetic flux is expelled from the interior at a rate determined principally by the transport of field in the normally conducting solid crust rather than by the rotation spin-down time. It is shown that a large fraction of the original magnetic flux cold remain in the superconducting interior of a binary neutron star, for example, Her X-1, after its initial rapid spin-down and would then be trapped by the inward radial movement of neutron vortices which follows. Author

A92-14147

MODELLING STELLAR SURFACE MAGNETIC FIELDS. I - SEARCH STRATEGIES AND UNIQUENESS

M. J. STIFT (Wien, Universitaet, Vienna, Austria) and M. GOOSSENS (Leuven, Katholieke Universiteit, Heverlee, Belgium) Astronomy and Astrophysics (ISSN 0004-6361), vol. 251, no. 1, Nov. 1991, p. 139-146. refs
Copyright

Within the framework of the Rigid Rotator hypothesis, an elaborate procedure for the modeling of stellar magnetic surface fields aimed at ensuring the uniqueness of the final models by means of appropriate search strategies is proposed. Two different field geometries are considered for this purpose. Using a sufficiently dense grid, the entire 6D or 4D parameter space for those models that best predict the observed integrated longitudinal field and integrated scalar field strength is explored. In a second step, detailed calculations of Stokes profiles for a few selected transitions make it possible to pick out the most promising starting models for the final iterative line profile modeling procedure, often leading simultaneously to the resolution of the ambiguity between obliquity angle and inclination in axisymmetric models. Illustrating the method

with the analysis of the magnetic variations of four well-observed Ap stars it is shown that the starting models derived are in reasonable agreement with the published spectra. Author

A92-16523**RELATIVISTIC ELECTRON-POSITRON BEAM FORMATION IN THE FRAMEWORK OF THE TWO-FLOW MODEL FOR ACTIVE GALACTIC NUCLEI**

GILLES HENRI and GUY PELLETIER (Grenoble, Observatoire, France) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 383, Dec. 10, 1991, p. L7-L10. refs

Copyright

A model for relativistic beam formation in AGN, in which electrons and positrons are generated by pair cascade on the UV photons of the accretion disk, is proposed. In situ turbulent acceleration by Alfvén waves in a pair plasma balances the Compton losses and prevents annihilation. It is shown that, above some threshold of the turbulence level, which is easily achieved, the pair creation becomes catastrophic, and so the dramatic increase of the relativistic pressure expels the pair plasma along the widening tubes. P.D.

A92-20810**SPHERICALLY SYMMETRIC, POLYTROPIC FLOW**

T. THEUNIS and M. DAVID (Antwerpen, Rijksuniversitair Centrum, Antwerp, Belgium) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 384, Jan. 10, 1992, p. 587-604. refs

Copyright

Determinations are given in closed form of the flow profile corresponding to stationary, spherically symmetric, polytropic flow around a gravitating and radiating point mass. The profile is a branch of a quartic equation, relating distance to the central object to, for example, the local sound speed. Two branches of this equation are complex. The other two describe three different types of flow: subsonic and transonic accretion flow, transonic wind, and supersonic, super-Eddington flow. At any position in this flow, a supersonic regime can be linked to a subsonic one, through an adiabatic shock. Given the profiles, the position of this shock is determined and vice versa. A stability criterion is derived for the continuous and shocked flows. Author

A92-27396**VORTICES ON ACCRETION DISKS**

M. A. ABRAMOWICZ, A. LANZA (SISSA; International Centre for Theoretical Physics, Trieste, Italy; NORDITA, Copenhagen, Denmark), E. A. SPIEGEL (Columbia University, New York; Ferrara, Università, Italy), and E. SZUSZKIEWICZ (Queen Mary and Westfield College, London, England) *Nature* (ISSN 0028-0836), vol. 356, March 5, 1992, p. 41-43. Research supported by NORDITA and NSF. refs

Copyright

It is suggested here that hot accretion disks produce vortices and flux tubes that cause significant dissipation and other observable physical effects. They will facilitate the escape of collimated radiation from deep within hot disks, producing spectral changes and time variability in the radiation from the disk. In the case of AGN, modification of X-ray spectra due to the presence of vortices on accretion disks permits several observational puzzles to be explained, including short-term variability and the low degree of linear polarization. C.D.

A92-47146**ROTATION OF THE NEUTRON-DRIP SUPERFLUID IN PULSARS - THE KELVIN PHONON CONTRIBUTION TO DISSIPATION**

P. B. JONES (Oxford, University, England) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 257, no. 3, Aug. 1, 1992, p. 501-506. refs

Copyright

Epstein and Baym have shown that excitation of the unperturbed Kelvin mode would produce a large resistive force on superfluid neutron vortices moving relative to the crust nuclei in a neutron star. It is shown here that real Kelvin phonon states are strongly

perturbed by the vortex-nucleus interaction. The phonon spectrum, for vortices not parallel with lattice vectors given by small Miller indices, is that of a 1D disordered system. The resistive force produced by one-phonon creation and annihilation is negligible for small vortex velocities (approximately less than or equal to 100 cm/s) but is large in the high-velocity limit. Two-phonon processes are estimated and may produce a significant small-velocity temperature-dependent contribution to the resistive force. Coupling of vortices with lattice phonons, however, is the more important mechanism of energy dissipation at low temperatures. Author

N92-20477# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

ATMOSPHERIC TRANSMISSION OF POLAR METEORITES

Ph.D. Thesis - Paris-Sud Univ.

PHILIPPE BONNY 1991 221 p In FRENCH; ENGLISH summary Translation was announced as ESA-TT-1283 (ISSN 0078-3781)

(ONERA-NT-1991-5; ETN-92-91026) Avail: CASI HC A10/MF A03

The atmospheric transmission of polar micrometeorites, in the range 50 to 300 micrometers, is analyzed. Three main characteristics of polar micrometeorites are incompatible with predictions of previous models of micrometeorite atmospheric entry: the high fraction of unmelted particles, the low mass loss of those that are melted, and a still partly preserved organic matter as suggested by laboratory analysis. The purpose of the study is to understand how these cosmic grains make it through so unexpectedly well. The current theory is reviewed, considering both the aerodynamic field and the material thermal reaction field. A law of vaporization from a mixture of melted oxides is developed. The effect an organic component has on heating and the pyrolysis is analyzed with a computational code that simulates the entire process of ablation of a charring material. A code was written to simulate the complete micrometeorite atmospheric entry trajectory, including melting, porosity change, loss of an organic component and vaporization of the major elements of the mineral component. The code is applied on the entire domain of micrometeorite velocity and angle of entry. The corridor of entry required for each of the three characteristics of the polar micrometeorites is evaluated. After weighting the angle and velocity allowed for each corridor, an entry velocity distribution compatible with actual polar micrometeorites characteristics is found by comparing computer-generated data with 'experimental'. The origin of the polar micrometeorites is discussed, considering the role they may have played in bringing organic matter to the early Earth. ESA

N92-22653# International Centre for Theoretical Physics, Trieste (Italy).

ELECTROSTATIC DRIFT VORTICES IN A HOT ROTATING STRONGLY MAGNETIZED ELECTRON-POSITRON PULSAR PLASMA

U. A. MOFIZ Jul. 1991 8 p

(DE92-614464; IC-91/177) Avail: CASI HC A02/MF A01

Electrostatic drift wave in a hot rotating and strongly magnetized electron-positron pulsar plasma is considered. Using relativistic two fluid equations a pair of coupled nonlinear equations is derived. It is shown that the wave can propagate in the form of two-dimensional dipolar vortices at ultrarelativistic temperature (T much greater than mc^2) of the plasma. The latter may affect the energy transport in the hot plasma, which can lead to a new turbulent state in the pulsar magnetosphere. DOE

LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

A92-14171

THE HYDRODYNAMICS OF ASPHERICAL PLANETARY NEBULAE. I - ANALYTIC EVALUATION OF HYDRODYNAMIC DIFFERENCE SCHEMES

V. ICKE (Leiden, Sterrewacht, Netherlands) Astronomy and Astrophysics (ISSN 0004-6361), vol. 251, no. 1, Nov. 1991, p. 369-381. refs

Copyright

The article begins a series devoted to the construction of numerical models of the hydrodynamic behavior of aspherical planetary nebulae. These models are based on the 'interacting-winds' picture of the formation of PN. A survey of the physics of the expected flow shows a formidable problem, because the outer wind can be hundreds of times slower and thousands of times denser than the inner wind. Such extreme circumstances require an extraordinarily cautious approach to the numerical solution of the relevant equations. The difficulties caused by these enormous discontinuities are discussed which are of a magnitude rarely encountered in other applications of numerical hydrocodes. A hydrodynamic code can be designed to deal with these problems, and first-order codes, such as particle-in-cell, are inadequate.

Author

A92-30456

THE VENUSIAN POLAR DIPOLE

F. W. TAYLOR (Oxford, University, England) IN: Middle atmosphere of Venus. Berlin, Akademie-Verlag Berlin, 1990, p. 93-97. refs

Copyright

The phenomenon of the Venusian dipole is described and characterized, and a qualitative explanation for its presence is presented. A new and fairly simple experiment is proposed which, if mounted on a future space mission, might supply the information required to construct a detailed theory that models its appearance and behavior satisfactorily. A diagram of the main characteristics of the dipole, a heuristic model of the cloud structure over the Venusian north pole, and the concept of a single instrument to obtain motion pictures of the dipole in the thermal IR are presented.

C.A.B.

N92-24642# Centre National d'Etudes Spatiales, Toulouse (France).

AEROSTAT FOR THE MARS 1994/1996 MISSION [L'AEROSTAT DE LA MISSION MARS 94/96]

C. TARRIEU /in ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 301-305 Nov. 1991 In FRENCH

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An original vehicle, the Aerosat, to be used as a means of locomotion, either near the Mars surface during atmospheric flight at a few kilometers altitude, or directly in contact with the ground when the Aerosat will be stabilized by its guiderope, is presented. A general description of the mission is given and concepts for the design of the balloon together with its dimensions and technological aspects are discussed.

ESA

N92-25679# Nice Univ. (France).

ASTRA: ALTIMETRY AND SOUNDING OF TITAN WITH A RADAR ON A DESCENDING CRAFT

P. KAMOUN (Nice Univ. (France).), J. C. ANNE (Alcatel Espace, Toulouse (France).), and PETER G. FORD (Massachusetts Inst. of Tech., Cambridge.) /in ESA, Radars and Lidars in Earth and Planetary Sciences p 71-78 Dec. 1991

Copyright Avail: CASI HC A02/MF A02

A small altimetric and sounding radar instrument to observe

and characterize the surface of Titan from a descending craft is proposed. It is a simple lightweight and cheap instrument with high scientific return. It could be very useful in gaining more information concerning the surface and subsurface of Titan. When associated with the same probe trajectory control, the ASTRA instrument could minimize the risk of landing in unsuitable terrain.

ESA

N92-32398# Padua Univ. (Italy). Dipartimento di Fisica.

TITAN'S ATMOSPHERE STRUCTURE FROM HUYGEN'S-ASI MEASUREMENTS

M. FABRIS, F. MARZARI, and V. VANZANI /in ESA, Symposium on Titan p 339-342 Apr. 1992

Copyright Avail: CASI HC A01/MF A01; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

A detailed procedure for reconstructing the trajectory, the velocity, and attitude temporal histories of the Huygens entry vehicle through Titan's atmosphere, and ultimately the structure of the atmosphere, is described starting from measurements of the aerodynamically induced accelerations experienced by the probe. This data will be obtained from the accelerometers for the Atmospheric Structure Instrument (ASI) carried aboard the Huygens probe.

ESA

SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

A92-27131

THE SUN, THE SOLAR WIND, AND COSMIC RAYS [SOLEIL, VENT SOLAIRE ET RAYONNEMENT COSMIQUE]

PIERRE LANTOS (Paris, Observatoire, Meudon, France) IN: Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings. Toulouse, France, Cepadues-Editions, 1992, p. 15-27. In French. refs

Copyright

The main characteristics of the sun and of its cycle, of the quiet and disturbed solar wind, and of solar proton events are described, along with the effect of solar activity on galactic cosmic rays. Particular emphasis is placed on solar activity effects on the space environment observed in 1989.

L.M.

SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

N92-23975# European Space Agency. European Space Operations Center, Darmstadt (Germany). Spacecraft Trajectory Branch.

PREDICTION OF SOLAR AND GEOMAGNETIC ACTIVITY FOR ESA LOW-FLYING SPACECRAFT

R. MUGELLESI (European Space Research Organization, Noordwijk (Netherlands).) and D. J. KERRIDGE (Natural Environmental Research Council, Edinburgh, Scotland) /in its The Reentry of Salyut-7/Kosmos-1686 p 63-72 Aug. 1991

Copyright Avail: CASI HC A02/MF A02

During the planning and operation of low altitude Earth orbit satellite missions, an important activity is orbit prediction over periods ranging from days to more than one year. It is also necessary to assess the impact of solar activity on the onboard electronics over the long term. In the orbital propagation model,

the dominant, and most difficult component to predict, is the drag force, as it is sensitive to the continuous variations of solar and geomagnetic activity. In the air density models presently available, solar activity is parameterized in terms of the solar radio flux F10.7, whereas geomagnetic activity is represented by the Kp (or the equivalent Ap) index. The availability of long, medium and short term prediction of the solar and geomagnetic activity is fundamental for satisfying the current operational needs. A method for medium and long term forecasting of the activities has been developed and implemented in a computer system. The method predicts monthly mean values of the F10.7 radio flux and Ap index. The SOLMAG software is currently used for mission analysis and in planning work for the ERS and EURECA missions. The performance of the prediction software is discussed. ESA

99

GENERAL

A92-30101

GOSLING

EWART C. WHITE (Royal Ordnance, PLC, Westcott, England) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, April 1992, p. 135-138.

Copyright

This paper describes the development of the Gosling boost motor over the period from 1953 to 1962. Some of the design problems encountered, together with the solutions are described. Most of these arose from the need to meet and combat the threat of strike aircraft with ever-increasing approach speeds. The final version, Gosling XV, entered service in the early 1960s.

Author

A92-30108

SKYLARK SOUNDING ROCKETS - PAST AND PRESENT

JOHN A. ELLIS (British Aerospace /Space Systems/, Ltd., Earth Observation and Science Div., Bristol, England) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, April 1992, p. 179, 180.

Copyright

The first Skylark rocket was launched in February 1957 some eight months before the launch of the world's first artificial satellite, Sputnik I. Skylark was designed and built by the Royal Aircraft Establishment at Farnborough in 1956 in collaboration with the Royal Society and was part of Britain's contribution to the International Geophysical Year 1957/58.

Author

A92-41820

THE TURBO-RAMJET GRIFFON [LE GRIFFON A TURBO-STATOREACTEUR]

A. TURCAT (Academie Nationale de l'Air et de l'Espace, Toulouse, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 105, 106. In French.

Copyright

A review is presented of the development and testing of the turbo-ramjet engine in the wind tunnel and various flying testbeds to its installation and flights powering the Griffon II aircraft. A number of the more important engineering modifications incorporated into the powerplant and aircraft installations are described.

R.E.P.

A92-55641

FRANCE AND THE PEENEMUENDE LEGACY

J. VILLAIN (SEP, Suresnes, France) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 24 p.

(IAF PAPER 92-0186) Copyright

The development of rocket and other aeronautical technologies

by German and French scientists trained at the German Peenemuende research facilities is reviewed. A substantial German contribution to French aeronautical technologies is demonstrated in the areas of liquid propellant research, missile components, and rocket design. Of particular interest is the redesign and reactivation of the V2 missile and associated nozzle, turbopump, and fuel-tank designs. C.C.S.

N92-11963# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EIGHTY YEARS OF AEROSPACE TECHNIQUE THROUGH ATMA BULLETINS [80 ANS DE TECHNIQUE AEROSPATIALE A TRAVERS LES BULLETINS DE L'ATMA]

J.-P. MAREC 1990 123 p In FRENCH; ENGLISH summary (ETN-91-90097) Avail: CASI HC A06/MF A02

The history of aerospace techniques during the last 80 years is reviewed from the rapid analysis of the memoirs presented at the sessions of ATMA (French acronym for the French association of maritime and aeronautical techniques) during this period. The main headings reviewed are: aerodynamics and hydrodynamics, flight mechanics, structures and materials, equipment, navigation, different types of vehicles, engines, aerospace programs and miscellaneous problems including safety. Some particularly significant passages of the memoirs are quoted and the text is abundantly illustrated by figures taken from the memoirs. A chronological index and an analytical index of the memoirs are given as appendices. ESA

N92-13916# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AGARD HIGHLIGHTS 91/2

Sep. 1991 38 p

(ISBN-92-835-0634-0; AD-B159157L) Copyright Avail: CASI HC A03/MF A01

Highlights of the activities of the Advisory Group for Aerospace Research and Development (AGARD) for 1991-92 are given. Topics covered include synthetic aperture radar (SAR), data processing, systems engineering and management, target acquisition, ground support equipment, electronic warfare, space-based radar, European air traffic control, and the research activities of the von Karman Institute. Author

N92-15961# European Space Agency, Paris (France).

ACTIVITIES REPORT OF THE EUROPEAN SPACE AGENCY Annual Report, 1990

NORMAN LONGDON, ed. and T. D. GUYENNE, ed. 1991 217 p Original contains color illustrations (ISSN 0258-025X)

(ETN-92-90679) Copyright Avail: CASI HC A10/MF A03

The scientific and technical projects developed by ESA in 1990 are summarized. The following programs are discussed: Hubble Space Telescope, Ulysses, solar observatory, Giotto mission, Huygens mission, Earth observation, telecommunication, Columbus, microgravity, and European astronauts corps. The results from scientific and technological research are presented. Data handling and technical infrastructure facilities, which are ESA basic activities, are included. Concerning the installations, the following projects are discussed: ESAMET, computer systems, ground facilities for space systems, mission support, satellite operations, and ESA establishments. The ESA administrative organization and structure are summarized. ESA finance, contracts and international relations are reported. ESA

N92-17928# Manchester Univ. (England). Aeronautical Engineering Group.

SYDNEY GOLDSTEIN FRS HON FRAES: AN APPRECIATION

J. A. D. ACKROYD 1989 18 p

(AERO-REPT-8903; ETN-92-90912) Avail: CASI HC A03/MF A01

The contribution of Goldstein to aeronautical technology in Britain is reviewed. The history of the boundary layer concept is described, with reference to theories of Prandtl, Kutta, and

Zhukonskii. A biography of Goldstein with emphasis on his research activities is presented. ESA

N92-19411# European Space Agency, Paris (France).

CATALOGUE OF ESA PATENTS

P. A. KALLENBACH, comp. and B. BATTRICK, comp. Jul. 1991 45 p Revised Original contains color illustrations (ISSN 0379-6566)

(ESA-SP-1131-REV-1; ISBN-100-05-1131; ETN-92-90748)

Copyright Avail: CASI HC A03/MF A01; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 25 Dutch guilders

This catalogue of ESA patents is published with the aim of making European industry aware of inventions developed by ESA staff. These inventions could be of use in providing alternative solutions to certain technical problems occurring in industrial activities, whether directly related to Space or not. The catalogue consists of two parts: a chronological list of references relating to patents being maintained by ESA, each identified by a PAT number and a title; and an index in which the patent references are categorized by subject. Each patent reference includes the patent or application number and date relating to the initial filing of an invention, this date thus being the 'priority date' in the event of other patent applications being made for the same invention. The applicant is ESA in most cases. In some cases, patents may have been filed together with another party. Each reference includes the name(s) of inventor(s), generally ESA staff members, although contractors or others could be mentioned as inventors or co-inventors. The field 'other applications' broadly refers to countries in which the relevant invention was protected subsequent to the initial filing. A brief summary is given for each invention, together with its objective and current potential applications. The subject index allows ESA inventions to be identified in the context of broad subject headings. In some cases, the same patent references may appear under more than one subject heading.

ESA

N92-24351# Minister fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein, Westfalen (Germany).

SUBJECT SPACE 2: A DOCUMENTATION ON SPACE RESEARCH IN NORTH-RHINELAND-WESTPHALIA IN THE PERIOD 1985-1990 [THEMA WELTRAUM 2: EINE DOKUMENTATION DER WELTRAUMFORSCHUNG IN NORDRHEIN-WESTFALEN IN DEN JAHREN 1985-1990]

Dec. 1990 157 p In GERMAN

(ETN-92-91068) Avail: CASI HC A08/MF A02

Subjects in the field of Earth observation, satellite communication, astronomy, astrophysics, geophysics, planetary physics, development of orbital systems and robotics, space transportation systems, and flow simulation are discussed. Much of the research, presented herein, is not yet completed. Therefore, the abstracts were not treated in the usual way.

ESA

N92-25413# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT]

THOMAS H. WEYER, ed. and HELGA ZIMMERMANN, ed. Feb. 1991 52 p In GERMAN Original contains color illustrations (ISSN 0937-0420)

Avail: CASI HC A04/MF A01

Various journal articles concerned with aeronautics, astronautics, and energy technology are presented. Some of the topics covered include: locating acoustic blade-vortex interaction sources; prediction of laminar-turbulent transition in laminar flow; an airworthy experimental system for modern navigation and reconnaissance methods; a planning system for the Frankfurt airport; rotors in wind tunnels; interdisciplinary research cooperation in aeronautics and astronautics; process control to set mach number ratios for jet-engine intake measurements; aerodynamic

configuration verifications on spacecraft; and solar energy conversion efficiency. K.S.

N92-26086# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT]

THOMAS H. WEYER, ed. and HELGA ZIMMERMANN, ed. Nov. 1991 60 p In GERMAN Original contains color illustrations (ISSN 0937-0420)

Avail: CASI HC A04/MF A01

Various articles are presented in the areas of engineering physics, physical combustion chemistry, thermodynamics, construction methods and design research, process engineering, and telecommunications. Some of the topics covered include: high performance lasers for aerospace applications; laser development; combustion products of hazardous materials; solar radiation conversion to chemical energy; development of a latent heat accumulator; continuous fiber reinforced thermoplastics; ceramic fibers; an absorption heat pump; and digital radio broadcasting.

K.S.

N92-29218# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Hauptabteilung Planung

DLR RESEARCH REPORTS AND COMMUNICATIONS Annual List, 1990 [JAHRESVERZEICHNIS 1990.

DLR-FORSCHUNGSBERICHTE UND DLR-MITTEILUNGEN]

W. WOLKE Jul. 1991 41 p In GERMAN

(ISSN 0939-2971)

(ETN-92-91391) Avail: CASI HC A03/MF A01

Abstracts on the following are presented: flight mechanics, dynamics of flight systems, flight medicine, air traffic, flow mechanics, aerodynamics, propulsion, chemical propulsion, structural mechanics, aeroelasticity, materials, space simulation, high frequency, optoelectronics, physics, thermodynamics, wind tunnels, applied data technique, and data processing. ESA

N92-29219# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Presse- und Oeffentlichkeitsarbeit.

ACTIVITIES REPORT OF THE DLR Annual Report, 1990-1991 [JAHRESBERICHT 1990/91 (DLR)]

THOMAS H. WEYER Sep. 1991 97 p In GERMAN

(ISSN 0938-2194)

(ETN-92-91392) Avail: CASI HC A05/MF A02

Subjects covered were: simulation and measuring instruments for air navigation and environment, the D2 space mission management project, satellite data for environmental research, ISIS (Intelligent Satellite Information System) for ecological mapping, robotics as a help to space navigation, and 'clean' combustion through computerized simulation of complex combustion processes. ESA

N92-30996 Institut d'Aeronomie Spatiale de Belgique, Brussels. **ASTRONAUTICS 1977-1990 [ASTRONAUTIQUE 1977-1990]**

J. VERCHEVAL 1991 300 p In FRENCH

(ISSN 0065-3713)

(AERONOMICA-ACTA-F-42-1991; ETN-92-91705) Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

The annual activities in the field of astronautics from 1977 until 1990 are described. Emphasis is placed on the scientific missions as well as the manned flights. An alphabetical list of satellites with their orbital elements and other essential data are pointed out in each annual balance. ESA

99 GENERAL

N92-33694# National Aerospace Lab., Amsterdam
(Netherlands).

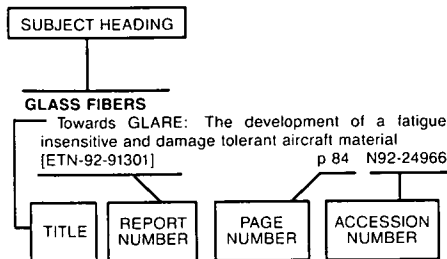
**ACTIVITIES REPORT OF THE NATIONAL AEROSPACE
LABORATORY Annual Report, 1990 [STICHTING NATIONAAL
LUCHT- EN RUIMTEVAARTLABORATORIUM JAARVERSLAG
1990]**

31 Dec. 1990 114 p In DUTCH

(ETN-92-92053) Avail: CASI HC A06/MF A02

In the field of flows, research and development activities were carried out in the area of theoretical and numerical methods. In the field of aircraft, the evaluation and certification of the Fokker 50 and Fokker 100 were accomplished. In the field of constructions and materials, research activities were carried out in the areas of aircraft loading, dynamical behavior of constructions, strength and stiffness of constructions, crack growth, composites, fiber reinforced laminates, aluminum alloys, high temperature materials, corrosion and erosion, and damage assessment. Astronautics research was made in the fields of satellite positioning, heat budget, microgravity, robotics, and remote sensing. Research in the field of computer aided engineering was carried out. ESA

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, a title extension is added, separated from the title by three hyphens. The accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence.

A

- A-300 AIRCRAFT**
Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- A-310 AIRCRAFT**
The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809
- A-320 AIRCRAFT**
British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023
The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
Flight simulation and digital flight controls p 115 N92-28526
Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- A-7 AIRCRAFT**
Fatigue management for the A-7P p 79 N92-18593
- ABLATION**
Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004
- ABLATIVE MATERIALS**
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- ABSORPTIVITY**
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- ABSTRACTS**
List of reports, 1989 p 278 N92-71169
List of reports, 1990 p 278 N92-71170

ACCELERATED LIFE TESTS

- New accelerated corrosion test methods [MBB-Z-0406-91-PUB] p 150 N92-32895

ACCELERATION

- Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 N92-22209

ACCELERATION (PHYSICS)

- Spacecraft low frequency residual acceleration [IAF PAPER 92-0970] p 133 A92-57328
Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 N92-11967

ACCELERATION PROTECTION

- High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996

ACCELERATION STRESSES (PHYSIOLOGY)

- High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
Circulatory biomechanics effects of accelerations p 248 N92-18991

- Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926

ACCELERATION TOLERANCE

- G-tolerance and spatial disorientation: Can simulation help us? p 248 N92-28534

ACCELEROMETERS

- Short time force measurement system p 114 N92-15001
Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926

ACCEPTABILITY

- Validation of simulation systems for aircraft acceptance testing p 86 N92-28531

ACCIDENT INVESTIGATION

- JAS 39 Gripen progress report p 67 A92-16058

ACCIDENT PREVENTION

- Human factors and simulation p 55 A92-53236

ACCRETION DISKS

- Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523
Spherically symmetric, polytropic flow p 284 A92-20810

- Vortices on accretion disks p 284 A92-27396

ACCUMULATIONS

- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692

ACOUSTIC ATTENUATION

- Inter-noise 90: Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vols. 1 & 2 [ISBN 91-7848-224-0] p 266 A92-39042
Airport noise contours - Converting from NNI to Leq p 227 A92-39053

- Computation of aircraft noise exposure using digitized topography data p 227 A92-39058

- Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

ACOUSTIC COUPLING

- Elasto-acoustic damped vibrations - Finite element and modal reduction methods [ONERA, TP NO. 1992-52] p 218 A92-48613

- Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 N92-21237

ACOUSTIC EMISSION

- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624

ACOUSTIC EXCITATION

- A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development [IAF PAPER 91-288] p 130 A92-14714

- Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085

- Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087

ACOUSTIC FREQUENCIES

- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 N92-24343

ACOUSTIC MEASUREMENT

- Acoustic characteristics of anechoic chamber at FFA [FFA-TN-1990-43] p 268 N92-12599

- Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

- The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 N92-15938

- Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) [ONERA-RT-16/3641-PY] p 269 N92-20387

- Acoustic isolation of layers p 265 A92-12345

- Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363

- Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044

- Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169

- Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386

- Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) [ONERA-RT-16/3641-PY] p 269 N92-20387

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

- Integrated Design Analysis and Optimisation of Aircraft Structures
[AGARD-LS-186] p 85 N92-28469
- Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- ACTIVE GALACTIC NUCLEI**
Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523
- ACTUATOR DISKS**
On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973
The role of crack growth in defect assessment [PNR-90798] p 220 N92-20909
- ACTUATORS**
Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- ADA (PROGRAMMING LANGUAGE)**
Ada --- design and use for aerospace software p 255 A92-19395
ARINC and the avionics of commercial aircraft. II p 60 A92-37072
Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
A practical experience of Ada for developing embedded software p 257 N92-12465
Software methodologies for safety critical systems p 257 N92-12467
- ADAPTERS**
Improvement of separations of practice bombs from a multiple bomb adapter [NLR-TP-90307-U] p 86 N92-28634
Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
- ADAPTIVE CONTROL**
Project of an adaptive multiaxial autopilot with learning pilot control [ETN-92-90592] p 107 N92-15072
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
- ADAPTIVE FILTERS**
Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293
Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
- ADHESIVE BONDING**
Joining of composite materials to metals p 211 A92-10695
Dispersion curves analysis for bonded plates at low F_d p 217 A92-13540
The evolution from bonded F27 aircraft to Aral structures p 3 A92-41177
Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- ADIABATIC CONDITIONS**
Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 N92-29713
- ADIABATIC FLOW**
The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482
- ADJUSTING**
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 N92-19013
- ADVANCED VERY HIGH RESOLUTION RADIOMETER**
Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340
Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969
- ADVECTION**
Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451
Tracer transport in the middle atmosphere p 229 N92-26473
Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
- AERIAL PHOTOGRAPHY**
Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124
Aircraft experiments with visible and infrared sensors p 206 A92-37159
The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing p 223 A92-44167

AEROACOUSTICS

- Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics [ONERA, TP NO. 1992-27] p 73 A92-48589
Calculation of noise generated in flows on the basis of an aerodynamic/acoustic decomposition [ONERA, TP NO. 1992-35] p 267 A92-48596
Influence of geometrical parameters on helicopter rotor high speed impulsive noise [ONERA, TP NO. 1992-40] p 267 A92-48601
Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169
Aeroacoustics in inhomogeneous flow field [FFA-TN-1991-30] p 268 N92-12601
Linear acoustics in gas mixtures with rate processes p 269 N92-15013

AEROASSIST

- Atmospheric re-entry p 123 A92-33409
Solving the aeroassisted orbital transfer problem by using a sequential optimization approach [AIAA PAPER 92-4646] p 124 A92-55401

AEROBRAKING

- Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
An aerodynamic consideration of the re-entry and aerobraking environment of space vehicles [IAF PAPER ST-92-0017] p 27 A92-57363

AERODYNAMIC BALANCE

- Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 N92-27804
Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 N92-32479
Symposium on dynamic balancing p 221 N92-71104

AERODYNAMIC BRAKES

- Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836

AERODYNAMIC CHARACTERISTICS

- Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines [ONERA, TP NO. 1991-170] p 110 A92-16135
STS 2000 - A reference airbreathing SSTO [AIAA PAPER 91-5013] p 126 A92-17811
Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
Aerodynamic computations of high-speed transonic propellers [ONERA, TP NO. 1991-218] p 13 A92-26370
Elements of airplane performance --- Book [ISBN 90-6275-608-5] p 68 A92-26550
EUROFAR Airframe aerodynamic design p 70 A92-35750
Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764
The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
An aerodynamical analysis of 'seesaw' type rotor for autogyro p 24 A92-52034
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
The achievement of aerodynamic goals on the EH101 project through the 'single site' concept p 75 A92-56342
Effect of twin fins on isolated tailplane lift-curve slope [ESDU-91009] p 28 N92-11969
Vortex flow on a missile body: Experimental study and modeling p 32 N92-13013
An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023
Aerodynamic development of the X-31 aircraft for the high angle of attack region [MBB-FE211-S-PUB-452] p 77 N92-17313
The Goldstein Engineering Research Laboratory [AERO-REPT-8906] p 5 N92-18322
X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782
Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692

- Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment p 56 N92-21697
Compressing the compressor [PNR-90824] p 99 N92-21848
First approach to an integrated fin design p 83 N92-23236
Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 84 N92-23951
Panel methods for aerodynamic analysis and design p 84 N92-23955
Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 N92-27804
Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870
Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
Vortex flow aerodynamics [AGARD-AR-299] p 50 N92-30947
Yacht sail aerodynamics. Part 1: Optimising overall performance [TT-8903-PT-1] p 52 N92-70499

AERODYNAMIC COEFFICIENTS

- Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes [ONERA, TP NO. 1991-237] p 13 A92-26387
Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155
An aerodynamic consideration of the re-entry and aerobraking environment of space vehicles [IAF PAPER ST-92-0017] p 27 A92-57363
Drag coefficients with applications to satellite orbits p 133 N92-11069
Maximum lift of wings with trailing-edge flaps at low speeds [ESDU-91014] p 28 N92-11970
A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032
Transitional flows around re-entry bodies p 38 N92-15035
Computation of aerodynamic coefficients on Hermes-Arianes configuration p 38 N92-15040
A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows [ESDU-91021] p 39 N92-15970
Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution p 39 N92-15973
Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds [ESDU-92002-SUPPL] p 51 N92-32782

AERODYNAMIC CONFIGURATIONS

- Design and performance of advanced blading for a high-speed HP compressor [ASME PAPER 91-GT-374] p 9 A92-15718
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
Recent developments at the Shoeburyness STOVL test facility p 111 A92-45314
An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations [AIAA PAPER 92-2613] p 20 A92-45487
The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations [AIAA PAPER 92-2619] p 256 A92-45492
An unstructured mesh generation algorithm for three-dimensional aeronautical configurations p 262 A92-47053
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079

- Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090
- Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 A92-13018
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 A92-14973
- Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980
- Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 A92-14987
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 A92-15027
- Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 A92-15040
- Grid impact on 3D hypersonic flows p 39 A92-15041
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations p 191 A92-18221
- X-31: Discussion of steady state and rotary derivatives p 81 A92-18789
- The evolution of the bypass engine [PNR-90832] p 99 A92-21850
- Recent developments at the Shoeburyness (England) STOVLT Test Facility [PNR-90806] p 115 A92-22096
- Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 A92-27452
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 A92-28660
- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 A92-32730
- System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 A92-70576
- AERODYNAMIC DRAG**
- Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- Base bleed technology in perspective p 17 A92-39427
- An aerodynamical analysis of 'seesaw' type rotor for autogyro p 24 A92-52034
- Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
- Drag coefficients with applications to satellite orbits p 133 A92-11069
- Resolution of Navier-Stokes equations around profiles: Drag evolution [ONERA-RTS-86/1685-AY-156A] p 186 A92-11310
- Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 A92-27706
- Basic concepts on boundary layers p 44 A92-27707
- Drag reduction: An industrial challenge p 44 A92-27708
- Boundary layer transition: Prediction, application to drag reduction p 44 A92-27711
- Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 A92-27714
- AERODYNAMIC FORCES**
- Blade defect force investigation in a compressor cascade p 6 A92-13233
- Prediction of generalized aerodynamic forces following linearized supersonic theory [ONERA, TP NO. 1991-114] p 9 A92-16093
- Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
- A note on the Kutta condition in Glauert's solution of the thin airfoil problem p 16 A92-37933
- Equilibrium configurations in a tethered atmospheric mission [AAS PAPER 91-543] p 124 A92-43391
- ATTAS flight test and simulation results of the advanced gust management system LARS [AIAA PAPER 92-4343] p 106 A92-55332
- Short time force measurement system p 114 A92-15001
- Dynamic wind tunnel tests on control of forebody vortices with suction p 107 A92-18793
- Aeroservoelastic stability of aircraft at high incidence p 108 A92-18795
- Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 A92-23974
- Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 A92-27804
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 A92-27946
- Direct coupling of fluid structure in transonic aeroelasticity p 46 A92-27954
- AERODYNAMIC HEAT TRANSFER**
- Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126
- Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
- Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 A92-15003
- Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 A92-23974
- AERODYNAMIC HEATING**
- Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392
- Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
- Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 A92-25959
- AERODYNAMIC INTERFERENCE**
- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336
- Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- Lift-curve slope of wing-body combinations [ESDU-91007] p 28 A92-11968
- Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures [DLR-FB-91-09] p 113 A92-12005
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Aircraft aerodynamics and stability and control during air-to-air refuelling [AERO-REPT-9017] p 107 A92-18321
- Survey of experimental techniques for performance prediction p 84 A92-23954
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TR-88072-U] p 49 A92-29884
- An investigation into the interface between three closely spaced axis-symmetric bodies at subsonic speed [CRANFIELD-AERO-9114] p 50 A92-31514
- Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions [PB92-138577] p 118 A92-70574
- AERODYNAMIC LOADS**
- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
- Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients p 123 A92-15818
- Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements [ONERA, TP NO. 1991-157] p 9 A92-16125
- Theoretical study and prediction of BVI noise including close interactions [ONERA, TP NO. 1991-174] p 265 A92-16138
- The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- General model of isolated helicopter blade for stability investigation p 71 A92-35774
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- Simulation of helicopter see-saw rotor motion p 74 A92-56287
- Numerical simulation of unsteady rotor wakes p 27 A92-56352
- A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991 [FFA-TN-1991-24] p 219 A92-12313
- Review of aircraft dynamic loads due to flow separation p 31 A92-13008
- Numerical simulation of vortex flows past impulsively started wings p 33 A92-13028
- Fatigue life behaviour of composite structures p 145 A92-18577
- Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device p 78 A92-18583
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 A92-27947
- Computation of flutter boundaries in the time and frequency domain p 46 A92-27952
- Vortex flow aerodynamics [AGARD-AR-299] p 50 A92-30947
- Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 A92-32479
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program [PB92-138676] p 53 A92-70590
- AERODYNAMIC NOISE**
- High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel [ONERA, TP NO. 1991-124] p 9 A92-16102
- Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors [ONERA, TP NO. 1991-178] p 10 A92-16140
- The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758
- Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044
- Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
- Jet noise classical theory and experiments p 268 A92-10602
- Airframe noise p 268 A92-10605
- The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 A92-15938
- Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 A92-29201
- AERODYNAMIC STABILITY**
- Blade instability of horizontally stoppable rotors p 106 A92-56308
- Rotorcraft system identification [AGARD-AR-280] p 75 A92-11001
- Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter [FFA-TN-1991-22] p 76 A92-11993
- Aerodynamic development of the X-31 aircraft for the high angle of attack region [MBB-FE211-S-PUB-452] p 77 A92-17313
- X-31: Discussion of steady state and rotary derivatives p 81 A92-18789
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 A92-18794
- Aeroservoelastic stability of aircraft at high incidence p 108 A92-18795
- AERODYNAMIC STALLING**
- Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil [AIAA PAPER 92-0027] p 11 A92-22149
- Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803
- Measurements of the dynamic stall vortex convection speed p 27 A92-56351
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 A92-18779
- AERODYNAMICS**
- A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
- A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
- Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
- Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow [REPT-90/59] p 29 A92-11982
- Vortex Flow Aerodynamics [AGARD-CP-494] p 30 A92-12996
- Review of aerodynamic design in the Netherlands p 76 A92-13929

- Recent progress in inverse methods in France p 97 N92-13938
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933
- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679
- Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193
- Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227
- Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950
- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
- Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712
- Yacht sail aerodynamics. Part 1: Optimising overall performance [TT-8903-PT-1] p 52 N92-70499
- Yacht sail aerodynamics. Part 3: Achievable jibsail specification [ISBN-0-904947-17-3] p 52 N92-70513
- Yacht sail aerodynamics. Part 2: Achievable mainsail specification [ISBN-0-904947-16-5] p 52 N92-70514
- LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983
- List of reports, 1989 p 278 N92-71169
- List of reports, 1990 p 278 N92-71170
- ### AEROELASTICITY
- Optimization of the flutter load by material orientation p 217 A92-15222
- Linear panel flutter of an elliptic cylindrical shell p 218 A92-21216
- Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics [ONERA, TP NO. 1992-27] p 73 A92-48589
- Advances in aircraft modal identification [ONERA, TP NO. 1992-47] p 105 A92-48608
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- Simulation of helicopter see-saw rotor motion p 74 A92-56287
- Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 N92-10989
- Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795
- A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
- Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000
- Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227
- The structural optimization system OPTSYS: Current status and applications p 83 N92-23232
- Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233
- Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
- Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940
- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
- Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950
- Direct coupling of fluid structure in transonic aeroelasticity p 46 N92-27954
- Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958
- Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 N92-28471
- Structural optimization of aircraft p 86 N92-28472
- Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474
- MBB-LAGRANGE: A general structural reliability and optimization structural system [MBB/FW321/S/PUB/467] p 220 N92-30423
- Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 N92-32776
- Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 N92-34161
- Unsteady wind tunnel tests p 109 N92-34166
- ### AERONAUTICAL ENGINEERING
- BA's 777 p 74 A92-51580
- 777 shaping up p 74 A92-52300
- A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991 [FFA-TN-1991-24] p 219 N92-12313
- Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 N92-14397
- Sydney Goldstein FRS Hon FRAeS: An appreciation [AERO-REPT-8903] p 286 N92-17928
- The Goldstein Engineering Research Laboratory [AERO-REPT-8906] p 5 N92-18322
- DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
- Aeronautical Engineering Group publications, 1950 - present [AERO-REPT-8907] p 202 N92-29683
- Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675
- Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694
- ### AERONAUTICAL SATELLITES
- Aeronautical satellite system test and implementation p 158 N92-24095
- Inmarsat aeronautical mobile satellite system: Internetworking issues p 158 N92-24098
- Future developments in aeronautical satellite communications p 158 N92-24167
- ### AERONAUTICS
- Iberia's Aeronautical Mapping Application (ACA) p 60 A92-37073
- A review of UK aviation policy [TT-9107] p 5 N92-12988
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- ### AEROSOLS
- Aerosol behavior in supersonic flows [ONERA, TP NO. 1991-155] p 206 A92-16124
- Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
- ### AEROSPACE ENGINEERING
- Joining of composite materials to metals p 211 A92-10695
- MA alloys for aerospace applications --- Mechanical Alloying p 149 A92-26128
- Modelling of aerospace materials - Not just a pretty picture p 212 A92-33363
- Why composites wait in the wings p 144 A92-35475
- Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197
- Eighty years of aerospace technique through ATMA bulletins [ETN-91-90097] p 286 N92-11963
- Software product assurance requirements for ESA space systems [ESA-PSS-01-21-ISSUE-2] p 257 N92-14631
- Implementation of the total quality management concept within space business p 275 N92-18640
- Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- Future technologies for space: New product assurance concepts p 153 N92-18650
- Why is space software special? p 258 N92-20626
- Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 N92-28579
- DLR research reports and communications [ETN-92-91391] p 287 N92-29218
- Activities report of the DLR [ETN-92-91392] p 287 N92-29219
- Maintainability requirements for ESA space systems [ESA-PSS-01-50-ISSUE-1] p 217 N92-29878
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
- SCOPE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- List of reports, 1989 p 278 N92-71169
- List of reports, 1990 p 278 N92-71170
- ### AEROSPACE ENVIRONMENTS
- Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
- The sun, the solar wind, and cosmic rays p 285 A92-27131
- Issues involved in defining outer space, space object and space debris p 282 A92-51856
- Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
- A history of the scientific study of living organisms in space [IAF PAPER ST-92-0022] p 254 A92-57366
- An overview of ESA cryocooler activities p 154 N92-25850
- Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851
- A heat switch for space cryocooler applications p 160 N92-25852
- The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853
- Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108
- Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118
- Space: Part of Europe's environment p 122 N92-70627
- ### AEROSPACE INDUSTRY
- Sweden and the space plane - A small country with high ambition [AIAA PAPER 91-5005] p 119 A92-17804
- Twilight of the machine builders p 279 A92-20515
- Insurance turns the corner p 278 A92-20516
- Reducing risks p 278 A92-22725
- 36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
- Australian space - Looking for a direction p 120 A92-36073
- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- Sunrise aerospace --- technology development in the Pacific Rim p 3 A92-46448
- Procurement doubts threaten research p 275 A92-47974
- An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- France and the Peenemuende legacy [IAF PAPER 92-0186] p 286 A92-55641
- Military and civil software standards and guidelines for guidance and control p 257 N92-12452
- Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076
- Space technology and industries in Norway [NSC-REPT(91)-8] p 153 N92-19521
- European industrial capabilities to provide meteorological space systems p 228 N92-25238
- Tasks of the council and general secretary of the Commission for Space Industry (Finland) p 276 N92-25785
- MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686
- ### AEROSPACE MEDICINE
- Spinal X-ray screening of high performance fighter pilots p 245 A92-15959
- Gravity effects on reproduction, development, and aging p 244 A92-34193
- Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214

- Problems experienced by man when constructing giant structures in space p 251 A92-40438
- Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine p 244 A92-13547
- [AGARD-AG-324] p 250 A92-13548
- The pilot flight surgeon bond p 250 A92-13548
- Domestic problems and aviator family support p 251 A92-13555
- Fear of flying p 251 A92-13556
- High Altitude and High Acceleration Protection for Military Aircrew p 247 A92-18972
- [AGARD-CP-516] p 247 A92-18972
- Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 A92-19008
- Fixed wing night attack EO integration and sensor fusion p 253 A92-19009
- G-tolerance and spatial disorientation: Can simulation help us? p 248 A92-28534
- ### AEROSPACE PLANES
- Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
- Hypersonic materials p 143 A92-18002
- French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683
- Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510
- Thermographic gust wind tunnel measurements [ONERA-RF-31/3409-PY] p 29 A92-11972
- Large thin composite thermostructural parts p 134 A92-23821
- Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 A92-29629
- Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics [MBB-FE-202-S-PUB-0464-A] p 48 A92-29648
- Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 A92-29649
- Aerothermodynamic challenges of the Saenger space-transportation system [MBB-FE-202-S-PUB-0462-A] p 129 A92-29680
- ### AEROSPACE SAFETY
- Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370
- Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 A92-18607
- International collaboration in PA and safety, the Eurospace PA-Panel p 215 A92-18608
- Organisational robustness for manned space flight p 152 A92-18618
- Quality assurance of safety and risk analysis p 215 A92-18629
- Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 A92-18630
- Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 A92-18632
- Safety risk management for ESA space systems p 153 A92-18635
- Why quantify risk? p 153 A92-18637
- A product assurance engineering concept for complex space systems p 216 A92-18645
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 A92-18655
- Hermes: Astronaut safety during launching and reentry phases p 126 A92-20774
- Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 A92-20786
- The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 A92-31813
- ### AEROSPACE SCIENCES
- Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- Space activities in Italy p 121 A92-53457
- The French space programme p 121 A92-53458
- An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- How to circulate official terminology [IAF PAPER 92-0346] p 277 A92-55761
- Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762
- Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764
- Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773
- Eighty years of aerospace technique through ATMA bulletins [ETN-91-90097] p 286 A92-11963
- Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 A92-25758
- Air museum p 283 A92-25761
- Society of space studies p 283 A92-25762
- Tasks of the council and general secretary of the Commission for Space Industry (Finland) p 276 A92-25785
- International Space University: Experiences and observations during Summer 1989 p 275 A92-25786
- List of reports, 1989 p 278 A92-71169
- List of reports, 1990 p 278 A92-71170
- ### AEROSPACE SYSTEMS
- Ada --- design and use for aerospace software p 255 A92-19395
- Aerospace Software Engineering in France p 255 A92-19404
- Aerospace software engineering in the United Kingdom p 255 A92-19405
- Aerospace software in Sweden p 255 A92-19406
- Space law and space technology - A common language p 281 A92-36695
- ACLICO: An aid system for designing bonded joints [REPT-911-430-134] p 152 A92-12146
- Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 A92-12517
- Development environment for digital manipulator simulators [PB91-222190] p 213 A92-16313
- Criticality management in space programs p 275 A92-18619
- A product assurance engineering concept for complex space systems p 216 A92-18645
- RAMREC: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 A92-18647
- Reliability modeling of the systems whose components have non-constant failure rate p 216 A92-18648
- Quality assurance requirements for ESA space systems [ESA-PSS-01-20-ISSUE-2] p 216 A92-19108
- Modeling and simulation of complex mechanical systems for space applications p 135 A92-24389
- The transpirator, an efficient and light evaporative cooler for space technology p 154 A92-26986
- ### AEROSPACE TECHNOLOGY TRANSFER
- In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
- An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- ### AEROSPACE VEHICLES
- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations [AIAA PAPER 92-2613] p 20 A92-45487
- CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
- Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 A92-13076
- ### AEROTHERMOCHEMISTRY
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 A92-14973
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
- Influence of chemical modelling on hypersonic flow p 37 A92-15015
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 A92-15029
- Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296
- ### AEROTHERMODYNAMICS
- Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- The German Hypersonics Technology Programme - Status report 1992 [IAF PAPER 92-0867] p 127 A92-57258
- Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 A92-11020
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 A92-14973
- Aerothermodynamic challenges for ESA programmes p 34 A92-14974
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 A92-14977
- Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980
- Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 A92-14994
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006
- Linear acoustics in gas mixtures with rate processes p 269 A92-15013
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 A92-15017
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 A92-15027
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 A92-15029
- Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 A92-15031
- Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 A92-15033
- Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 A92-15040
- Aerothermodynamic challenges of the Saenger space-transportation system p 39 A92-15042
- Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 A92-27475
- Steady and Transient Performance Prediction of Gas Turbine Engines [AGARD-LS-183] p 101 A92-28458
- Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 A92-29629
- Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics [MBB-FE-202-S-PUB-0464-A] p 48 A92-29648
- Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 A92-29649
- Aerothermodynamic challenges of the Saenger space-transportation system [MBB-FE-202-S-PUB-0462-A] p 129 A92-29680
- Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 A92-29713
- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB-FE-202/S/PUB/461] p 5 A92-30232
- LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 A92-70983
- ### AFTERBODIES
- Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 A92-32479
- ### AGING
- Ageing aircraft research in the Netherlands p 57 A92-30129
- Survey of French activities concerning structural airworthiness and aging aircraft p 57 A92-30130
- ### AGING (MATERIALS)
- Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 A92-33048
- ### AGING (METALLURGY)
- A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- ### AGREEMENTS
- Ageing aircraft research in the Netherlands p 57 A92-30129
- ### AGRICULTURE
- Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- Remote sensing of seasonal variations in albedo over southern Britain p 241 A92-33969

AIR BREATHING BOOSTERS

- STS 2000 - A reference airbreathing SSTD
[AIAA PAPER 91-5013] p 126 A92-17811
Potential hypersonic vehicles applications
[AIAA PAPER 91-5086] p 1 A92-17854

AIR BREATHING ENGINES

- Oriflame - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles
[IAF PAPER 91-207] p 126 A92-14705
Ground operations of a HTOL airbreathing launcher
[IAF PAPER 91-217] p 125 A92-14708
Propulsion system performance and integration for high Mach air breathing flight p 96 A92-46429
Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645
Open and closed loop guidance for an airbreathing winged launch vehicle
[IAF PAPER 92-0042] p 127 A92-55537
The German Hypersonics Technology Programme - Status report 1992
[IAF PAPER 92-0867] p 127 A92-57258

AIR COOLING

- Discharge coefficients of cooling holes with radiused and chamfered inlets
[ASME PAPER 91-GT-269] p 162 A92-15667

AIR DATA SYSTEMS

- Some important factors in turbulence in flight measurement p 90 A92-54324

AIR DEFENSE

- The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] p 91 N92-14046
Market directed thinking in a technological operation p 276 N92-23929
Optimal guidance anticipating missile performance p 128 N92-27902

AIR FLOW

- Linear panel flutter of an elliptic cylindrical shell p 218 A92-21216
Fokker 50 flameouts in icing conditions p 71 A92-35940
SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999
Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
The laminar natural convection on a horizontal surface [AERO-REPT-9015] p 191 N92-18236
Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955

AIR INTAKES

- A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines
[ASME PAPER 91-GT-392] p 162 A92-15722
Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction p 12 A92-24426
The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315
Turbulence control by intake [CERT-RF-67/5004-37] p 186 N92-12211
Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55] p 187 N92-12216
CFD contributions during hypersonic airplane intake design p 199 N92-27472

AIR JETS

- Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446

AIR LAND INTERACTIONS

- Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345

AIR LAW

- No end to incidents in airspace? III p 53 A92-23172
Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591
Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
The role of the notary under the laws of the Netherlands - With respect to the transfer of title and encumbrance of registered aircraft p 280 A92-35595
Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550
Re-engineering for real stage 3 compliance [PNR-90872] p 102 N92-33748

AIR MASSES

- The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048

AIR NAVIGATION

- Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934

- Transition to cooperative ATM system requires commitment --- Air Traffic Management p 59 A92-23297

- The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
Eurocontrol - UK detention rights p 280 A92-33048
The view from the airport p 60 A92-33438
Security rights in aircraft under Belgian law p 280 A92-35589

- A computerized flight inspection system --- for testing of basic air navigation ground facilities p 61 A92-43881

- The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 N92-10997
Market directed thinking in a technological operation p 276 N92-23929

- DLR research reports and communications [ETN-92-91391] p 287 N92-29218
Activities report of the DLR [ETN-92-91392] p 287 N92-29219

- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605

AIR PIRACY

- CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549

AIR POLLUTION

- Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354

- Environmentally sound [PNR-90776] p 228 N92-21743

AIR PURIFICATION

- A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892

AIR SEA ICE INTERACTIONS

- Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943

AIR START

- The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849

AIR TO AIR MISSILES

- An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222

AIR TO AIR REFUELING

- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system p 71 A92-35937
Aircraft aerodynamics and stability and control during air-to-air refuelling [AERO-REPT-9017] p 107 N92-18321

AIR TRAFFIC

- No end to incidents in airspace? III p 53 A92-23172
A systematic formulation, as an approach to air traffic [MBB-Z-0371-91-PUB] p 62 N92-10996
UK airmisses involving commercial air transport: September - December 1990 p 56 N92-21746
Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605

AIR TRAFFIC CONTROL

- The European ATC challenge p 58 A92-11877
Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291
Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299
Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134
Madrid's double airport p 110 A92-16231

- New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
Transition to cooperative ATM system requires commitment --- Air Traffic Management p 59 A92-23297

- Quantitative estimation of secondary surveillance radar information p 59 A92-24943

- The avoidance of collisions for Newtonian bodies with hidden variables p 59 A92-24945
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946

- Behind the screens --- development of Central Flow Management Unit for air traffic control p 59 A92-25520

- The real TCAS --- traffic alert and collision avoidance system p 54 A92-25521

- Eurocontrol - UK detention rights p 280 A92-33048
A European perspective on the co-operative air traffic management concept p 60 A92-33427
An aircraft manufacturer's perspective p 2 A92-33430

- The view from the airport p 60 A92-33438
Computation of aircraft geometric height under radar surveillance p 61 A92-40239
Terminal area traffic management p 61 A92-50122
Monopulse secondary surveillance radar and the mode-S surveillance system p 62 A92-53239
AGARD highlights 91/2 [ISBN-92-835-0634-0] p 286 N92-13916

- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041

- Design principles of automation aids for ATC approach control p 62 N92-19042
COMPAS system concept p 63 N92-19043
Evaluation of the COMPAS experimental system p 63 N92-19044

- Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045

- Steps toward acceptance p 63 N92-19046
Evaluation of the COMPAS operational system p 63 N92-19047

- Extension of the Frankfurt COMPAS for general application p 63 N92-19048
The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049

- The role of planning systems in future air traffic management p 64 N92-19050

- Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDIF [NLR-TR-88108-U] p 64 N92-19491

- Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 N92-20611
UK airmisses involving commercial air transport: September - December 1990 p 56 N92-21746

- Flight test of avionic and air-traffic control systems [ETN-92-91063] p 65 N92-25590

- ATTAS experimental cockpit and ATMOS for flight control components and systems investigations p 65 N92-25595
Testing of an experimental FMS p 85 N92-25596

- Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887

- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895

- On board planning of 4D-trajectories p 66 N92-27897

- Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905

- NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 N92-29204

- Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 N92-29615

AIR TRAFFIC CONTROLLERS (PERSONNEL)

- Quantitative estimation of secondary surveillance radar information p 59 A92-24943

- The real TCAS --- traffic alert and collision avoidance system p 54 A92-25521

- The role of planning systems in future air traffic management p 64 N92-19050

AIR TRANSPORTATION

- Air transport research in Germany p 1 A92-17095

SUBJECT INDEX

- The real TCAS --- traffic alert and collision avoidance system p 54 A92-25521
- An aircraft manufacturer's perspective p 2 A92-33430
- Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591
- Civil aircraft design in relation to airworthiness p 54 A92-39303
- Vigilance of aircrews during long-haul flights p 247 A92-45021
- Trends in commercial aircraft design - What evolution factors and what approach? [ONERA, TP NO. 1992-25] p 4 A92-48587
- Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 N92-22406
- The Eurofar program: An European overview on advanced VTOL civil transportation system [MBB-UD-0611-91-PUB] p 58 N92-30418
- The impact of air transport on the environment [PNR-90876] p 230 N92-33751
- ### AIR WATER INTERACTIONS
- A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
- Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 N92-29213
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- ### AIRBORNE EQUIPMENT
- Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
- A new thermometric instrument for airborne measurements in clouds p 88 A92-24918
- Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
- First results from the Netherlands SAR testbed 'PHARS' --- Phased array universal SAR p 221 A92-34903
- Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173
- Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme p 70 A92-35767
- Aircraft experiments with visible and infrared sensors p 206 A92-37159
- Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
- SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
- Introduction: Ocean air observation p 224 N92-23381
- Quick-look system p 224 N92-23393
- Applications of ASICs to avionics [AGARD-AG-329] p 92 N92-28376
- Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037
- ### AIRBORNE LASERS
- Single alexandrite laser source for airborne DIAL system p 210 A92-51228
- Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- ### AIRBORNE RADAR
- Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
- ### AIRBORNE SURVEILLANCE RADAR
- Monopulse secondary surveillance radar and the mode-S surveillance system p 62 A92-53239
- ### AIRBORNE/SPACEBORNE COMPUTERS
- ARINC and the avionics of commercial aircraft. II p 60 A92-37072

- Is the avionics system of the Hermes Spaceplane centralized or decentralized? p 139 A92-49258
- Computer software in civil aircraft p 256 A92-49302
- Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323
- The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 N92-21847
- Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 N92-29615
- ### AIRCRAFT
- Registration of aircraft in the aircraft registrar using the 'Leasing Decree' of the Federal Minister of Transport of February 12, 1991 p 279 A92-11215
- ### AIRCRAFT ACCIDENT INVESTIGATION
- How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308
- Engine reliability p 95 A92-39309
- Learning from aircraft accidents and incidents p 54 A92-39310
- Windscreens departure p 55 A92-42500
- The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994
- The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998
- Vigilance of aircrews during long-haul flights p 247 A92-45021
- Knowledge transfer and support systems in fighter aircraft p 251 A92-45047
- UK airmisres involving commercial air transport: September - December 1990 [ETN-92-91050] p 56 N92-21746
- Aircraft accident report: Unstabilized approach and loss of control NPA, Inc. dba United Express Flight 2415, British Aerospace BA-3101, N410UE, Tri-Cities Airport, Pasco, Washington, December 26, 1989 [PB91-910406] p 56 N92-21873
- Examination of aircraft warning and caution lights after shock testing [NLR-TP-89284-U] p 58 N92-30474
- ### AIRCRAFT ACCIDENTS
- The long-term psychological consequences of a major aircraft accident p 249 A92-13020
- Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382
- Civil aircraft design in relation to airworthiness p 54 A92-39303
- Human factors and simulation p 55 A92-53236
- Domestic problems and aviator family support p 251 N92-13555
- Aircraft accident report: Unstabilized approach and loss of control NPA, Inc. dba United Express Flight 2415, British Aerospace BA-3101, N410UE, Tri-Cities Airport, Pasco, Washington, December 26, 1989 [PB91-910406] p 56 N92-21873
- ### AIRCRAFT ANTENNAS
- Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315
- Electronically steerable antenna for aircraft p 156 N92-15272
- ### AIRCRAFT APPROACH SPACING
- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
- Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDIF [NLR-TR-88108-U] p 64 N92-19491
- ### AIRCRAFT CARRIERS
- Rafale M - Dassault's Squall at sea p 71 A92-37874
- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Approach and landing assisted by onboard image processing p 64 N92-21959
- Approach and landing guidance p 65 N92-21960
- Some implications for advanced STOLV operation from invincible class ships p 82 N92-21971
- Aircraft ship operations [AGARD-AR-312] p 85 N92-28468
- ### AIRCRAFT COMMUNICATION
- ARINC and commercial aircraft avionics. I p 60 A92-25655
- Aeronautical satellite system test and implementation p 158 N92-24095
- Inmarsat aeronautical mobile satellite system: Internetworking issues p 158 N92-24098
- ### AIRCRAFT COMPARTMENTS
- Acoustic isolation of layers p 265 A92-12345
- A survey of active control in aircraft cabins p 72 A92-39084

AIRCRAFT CONSTRUCTION MATERIALS

- The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998
- A320 handling, cockpit design improve on predecessor A320 p 73 A92-47969
- Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952
- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- ### AIRCRAFT CONFIGURATIONS
- Tomorrow's Goshawk flies p 68 A92-18001
- Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034
- Dornier 328 - A Daimler for commuters p 69 A92-30091
- Airbus - The family expands p 2 A92-30092
- Mass-transporter p 69 A92-34650
- The computation of three-dimensional flows using unstructured grids p 16 A92-37539
- Rafale M - Dassault's Squall at sea p 71 A92-37874
- Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- Two-point optimization of complete three-dimensional airplane configuration [AIAA PAPER 92-2618] p 73 A92-45491
- Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809
- Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782
- X-31: Discussion of steady state and rotary derivatives p 81 N92-18789
- Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951
- Preconsiderations on aircraft integration p 224 N92-23402
- Panel methods for aerodynamic analysis and design p 84 N92-23955
- Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 A92-27940
- Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods [NLR-TP-89119-U] p 47 N92-28659
- ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515
- The 3-D Euler flows around modern airplanes [PB92-138759] p 52 N92-70540
- ### AIRCRAFT CONSTRUCTION MATERIALS
- Use of composite materials for aeronautical structure p 143 A92-15303
- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- The first fifty years of composite materials in aircraft construction p 69 A92-32325
- Why composites wait in the wings p 144 A92-35475
- The evolution from bonded F27 to Arall structures p 3 A92-41177
- Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145
- Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- Steels for aerospace applications p 149 A92-52983
- Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 N92-14042
- Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045
- Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
- The search for new materials [PNR-90777] p 145 N92-21744
- Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000

- Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966
- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
- Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742
- Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307
- AIRCRAFT CONTROL**
- Flying the A340 iron bird p 67 A92-10666
- An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
- Aircraft ground vibration test by means of flight control surfaces [ONERA, TP NO. 1991-96] p 103 A92-16079
- Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094
- Aircraft control for take-off in windshear p 104 A92-36990
- Aircraft stabilization at large angles of attack p 105 A92-47785
- Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft p 107 N92-12004
- [RAE-TM-FS-1009] Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022
- Aircraft aerodynamics and stability and control during air-to-air refueling [AERO-REPT-9017] p 107 N92-18321
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
- Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
- X-31: Discussion of steady state and rotary derivatives p 81 N92-18789
- Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603
- Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
- A background to the handling qualities of aircraft [ESDU-92006] p 109 N92-32780
- AIRCRAFT DESIGN**
- Mirage 2000-5 - Dassault's delta described p 67 A92-16622
- The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- Four decades of transonic fighter design p 68 A92-20203
- Gust effects on a flexible aircraft p 68 A92-22474
- Tilting at targets --- tilt rotor aircraft development p 68 A92-25074
- 36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
- Dornier 328 - A Daimler for commuters p 69 A92-30091
- Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- The use of large teams in conceptual aircraft design [AIAA PAPER 92-1092] p 274 A92-33257
- Mass-transporter p 69 A92-34650
- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
- Civil aircraft design in relation to airworthiness p 54 A92-39303
- Aircraft structural design p 72 A92-39304
- Concorde flight testing - Powerplant and performance flying [SAE PAPER 912192] p 72 A92-40009
- Rafale: Program update - Development of a naval version p 72 A92-40035
- Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548
- Evolution of ASTOVL aircraft design p 72 A92-45311

- Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
- A340 handling, cockpit design improve on predecessor A320 p 73 A92-47969
- US Navy revisits escape modules p 73 A92-47975
- Trends in commercial aircraft design - What evolution factors and what approach? [ONERA, TP NO. 1992-25] p 4 A92-48587
- BA's 777 p 74 A92-51580
- Successful transfer of technology from a research and development laboratory to an Aerospace production unit p 4 A92-51808
- 777 shaping up p 74 A92-52300
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- Rapidly going nowhere? --- combat aircraft development in Russia p 74 A92-54545
- The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299
- Technology exploitation for in-service support of future rotorcraft p 4 A92-56327
- Review of aerodynamic design in the Netherlands p 76 N92-13929
- Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
- Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
- Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951
- Research on inverse methods and optimization in Italy p 97 N92-13956
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers [ESDU-91016-ADD] p 77 N92-15987
- Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 N92-18790
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- An evaluation of in-cabin safety features in passenger aircraft [ETN-92-90656] p 55 N92-20794
- The search for new materials [PNR-90777] p 145 N92-21744
- Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233
- Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950
- Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 84 N92-23951
- Computational procedures for preliminary design p 84 N92-23952
- Panel methods for aerodynamic analysis and design p 84 N92-23955
- CFD contributions during hypersonic airplane intake design p 199 N92-27472
- Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 N92-28471
- Structural optimization of aircraft p 86 N92-28472
- Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474
- Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 N92-28660
- Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650
- MBB-LAGRANGE: A general structural reliability and optimization structural system [MBB/FW321/S/PUB/467] p 220 N92-30423
- Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515
- Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694
- The Rolls-Royce Trent [PNR-90875] p 88 N92-33750
- Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 N92-34161
- Flutter models: Their design, manufacture, and ground testing p 109 N92-34164

- SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249
- Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
- System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
- AIRCRAFT DETECTION**
- Innovation in the laser warning sensor field p 89 A92-35742
- Aircraft tracking for structural fatigue p 79 N92-18584
- Aircraft tracking optimization of parameters selection p 79 N92-18585
- Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
- AIRCRAFT ENGINES**
- Three dimensional flow in a linear compressor cascade at design conditions [ASME PAPER 91-GT-114] p 8 A92-15565
- The selective bleed variable cycle engine --- aircraft propulsion [ASME PAPER 91-GT-388] p 93 A92-15720
- A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines [ASME PAPER 91-GT-392] p 162 A92-15722
- Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
- Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
- Air transport research in Germany p 1 A92-21014
- The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
- The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760
- The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
- Dutch security rights in aircraft and engines p 280 A92-35594
- Fokker 50 flameouts in icing conditions p 71 A92-35940
- Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
- Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
- The turbo-ramjet Griffon p 286 A92-41820
- VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306
- Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
- Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791
- CIS engines. I - The range revealed p 4 A92-47821
- Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982
- CIS engines - The range revealed. II p 96 A92-54546
- Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244
- Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
- ETOPS: A developing scene [PNR-90844] p 98 N92-20459
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 N92-21740
- Environmentally sound [PNR-90776] p 228 N92-21743
- Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 N92-22406
- Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490

- Steady and Transient Performance Prediction of Gas Turbine Engines p 101 N92-28458
[AGARD-LS-183]
- Practical considerations in designing the engine cycle p 102 N92-28460
- Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
- Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464
- Re-engineing for real stage 3 compliance [PNR-90872] p 102 N92-33748
- The impact of air transport on the environment [PNR-90876] p 230 N92-33751
- AIRCRAFT EQUIPMENT**
- Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928
- Airborne experimental FLIR program p 93 N92-32447
- AIRCRAFT FUEL SYSTEMS**
- Separation of external stores: Comparison of results [F+W-TF-2058] p 85 N92-26944
- AIRCRAFT GUIDANCE**
- Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
- Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
- Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928
- Flight management system back-up navigation for the A330/A340 aircraft p 106 A92-49326
- A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182
- DME growth elements and their use with MLS p 62 N92-14018
- Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates [DLR-FB-91-23] p 64 N92-20902
- Approach and landing guidance p 65 N92-21960
- Testing concept of a movement area guidance p 65 N92-25597
- Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
- On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 N92-29703
- Development of new flight procedures for the Microwave Landing System (MLS) [NLR-TP-91156-U] p 66 N92-32830
- AIRCRAFT HAZARDS**
- Lightning activity in microburst producing storm cells [ONERA, TP NO. 1991-98] p 235 A92-16080
- Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134
- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679
- Flight in adverse environmental conditions p 55 N92-21680
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
- AIRCRAFT ICING**
- Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds --- for aircraft icing p 53 A92-23302
- Aircraft icing [ONERA, TP NO. 1991-202] p 54 A92-26359
- Fokker 50 flameouts in icing conditions p 71 A92-35940
- Flying on thin ice p 54 A92-38375
- Effect of a deicing device on the induced drag of a lifting airfoil p 74 A92-51947
- A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349
- AIRCRAFT INDUSTRY**
- High costs force avionics links p 88 A92-22000
- Airbus - The family expands p 2 A92-30092
- German-GUS cooperation in civil aviation p 3 A92-47592
- Russian realities --- changes in aviation infrastructure p 4 A92-53250
- Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382
- Fundamentals of structural optimisation p 86 N92-28470
- Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742
- MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686
- AIRCRAFT INSTRUMENTS**
- Use of relative humidity sensors for planes measurement p 89 A92-32080
- Through the looking glass --- effectiveness of electronic flight instrument systems p 90 A92-46449
- Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678
- Introduction: Ocean air observation p 224 N92-23381
- Recommended system concept p 224 N92-23383
- Quick-look system p 224 N92-23393
- Preconsiderations on aircraft integration p 224 N92-23402
- Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870
- AIRCRAFT LANDING**
- The new airport aeronautical meteorological codes p 235 A92-13855
- Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft p 105 A92-47784
- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Approach and landing assisted by onboard image processing p 64 N92-21959
- Approach and landing guidance p 65 N92-21960
- Aircraft ship operations [AGARD-AR-312] p 85 N92-28468
- Trial of a slant visual range measuring device p 210 N92-31043
- AIRCRAFT MAINTENANCE**
- A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
- Ageing airliner census - Still flying safely p 54 A92-38374
- Windscreens departure p 55 A92-42500
- Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550
- Industrial practice in aeronautical maintenance p 3 A92-47774
- A knowledge-based assistant for diagnosis in aircraft maintenance p 5 N92-12538
- Methodology for assessment of skin repairs on Airbus aircraft p 219 N92-14428
- Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
- The G-222 aircraft individual tracking programme p 78 N92-18582
- Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device p 78 N92-18583
- Aircraft fatigue management in the Royal Air Force p 79 N92-18591
- Application of knowledge-based systems for diagnosis of aircraft systems [NLR-TP-90192-U] p 57 N92-28655
- Ageing aircraft research in the Netherlands p 57 N92-30129
- Survey of French activities concerning structural airworthiness and aging aircraft p 57 N92-30130
- A manufacturer's approach to ensure long term structural integrity p 57 N92-30133
- Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- AIRCRAFT MANEUVERS**
- The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- The use of inverse simulation for conceptual design p 70 A92-35738
- Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system p 71 A92-35937
- A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
- Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 N92-15065
- Manoeuvring Aerodynamics [AGARD-CP-497] p 80 N92-18778
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
- Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- AIRCRAFT MODELS**
- Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia --- aircraft models applied to real aircraft p 217 A92-12346
- Recent development of wind-tunnel test techniques at ONERA [ONERA, TP NO. 1991-135] p 110 A92-16110
- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum p 15 A92-32323
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
- A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
- Flutter models: Their design, manufacture, and ground testing p 109 N92-34164
- AIRCRAFT NOISE**
- Environmental impact of a future supersonic transport aircraft [ONERA, TP NO. 1991-132] p 226 A92-16108
- NATO CCMS aircraft noise study on receiver technology p 226 A92-39050
- Noise from military airfields in the United Kingdom p 226 A92-39052
- Airport noise contours - Converting from NNI to Leq p 227 A92-39053
- Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- DANSIM - Danish Airport Noise Simulation Model - Basic principles, experience, and improvements p 227 A92-39055
- DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
- Computation of aircraft noise exposure using digitized topography data p 227 A92-39058
- Advanced method for single event aircraft noise analysis p 266 A92-39060
- Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 A92-39064
- Do we really need 57 ways of rating aircraft noise? p 227 A92-39065
- A survey of active control in aircraft cabins p 72 A92-39084
- Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085
- Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086
- Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
- Progress towards quieter civil helicopters p 267 A92-52847
- Airframe noise p 268 N92-10605
- Re-engineing appears to offer best payback for young: Chapter 2 compliant aircraft [PNR-90848] p 98 N92-19939
- The impact of aircraft noise control technology [PNR-90846] p 269 N92-20461
- Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241
- Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201
- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- AIRCRAFT PERFORMANCE**
- Mirage 2000-5 - Dassault's delta described p 67 A92-16622
- Tomorrow's Goshawk flies p 68 A92-18001
- Elements of airplane performance --- Book [ISBN 90-6275-608-5] p 68 A92-26550
- Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094

- Sentinel 1000 flight test programme overview and preliminary results p 69 A92-33326
 [AIAA PAPER 92-1229] p 69 A92-33326
 Aircraft performance --- Book p 69 A92-33919
 [ISBN 0-521-36264-4] p 69 A92-33919
 Concorde flight testing - Powerplant and performance flying p 72 A92-40009
 [SAE PAPER 912192] p 72 A92-40009
 International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings p 3 A92-45302
 [ISBN 0-903409-68-2] p 3 A92-45302
 A progress report on ASTOVL control concept studies under the VAAC programme p 104 A92-45319
 The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
 Regional challenge --- flight test of Canadair Regional Jet p 74 A92-53121
 Rapidly going nowhere? --- combat aircraft development in Russia p 74 A92-54545
 The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299
 Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions p 75 A92-56809
 [AIAA PAPER 92-3985] p 75 A92-56809
 Variability of standard aircraft performance parameters [ESDU-91020] p 77 A92-17847
 Statistical methods applicable to analysis of aircraft performance data p 77 A92-18096
 [ESDU-91017] p 77 A92-18096
 Survey of experimental techniques for performance prediction p 84 A92-23954
 Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 A92-27870
 The Rolls-Royce Trent p 88 A92-33750
 [PNR-90875] p 88 A92-33750
- AIRCRAFT PILOTS**
 Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405
 Cardiological aspects of pilot's fitness to fly p 245 A92-16406
 The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257
 Pilot attitudes to cockpit automation p 250 A92-44926
 Pragmatic simulation, basics and techniques p 251 A92-45030
 Knowledge transfer and anticipation in airline piloting p 250 A92-45065
 Injuries associated with the use of ejection seats in Finnish pilots p 247 A92-50292
 Integrating machine intelligence into the cockpit to aid the pilot p 252 A92-12533
 The pilot flight surgeon bond p 250 A92-13548
 Aviation psychology in the operational setting p 250 A92-13550
 Domestic problems and aviator family support p 251 A92-13555
 Fear of flying p 251 A92-13556
 Limitations on helicopter operations in the aeronaval environment p 82 A92-21973
 Aircraft simulation and pilot proficiency: From surrogate flying towards effective training p 115 A92-28532
 Study of the loss of consciousness inflight by fighter aircraft pilots [ONERA-RTS-11/3446-EY] p 249 A92-28844
- AIRCRAFT POWER SUPPLIES**
 The engine inside p 94 A92-36126
- AIRCRAFT PRODUCTION**
 36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
 Aircraft structural design p 72 A92-39304
 The evolution from bonded F27 aircraft to Arall structures p 3 A92-41177
 Assembling the future p 3 A92-44895
- AIRCRAFT PRODUCTION COSTS**
 Lynx - A 50 year product? p 75 A92-56307
- AIRCRAFT RELIABILITY**
 Mind that restyle --- failure analysis of aircraft composite structures p 53 A92-13700
 Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
 Civil aircraft design in relation to airworthiness p 54 A92-39303
 p 95 A92-39309
 Engine reliability p 54 A92-39309
 Tornado structural fatigue life assessment of the German Air Force p 79 A92-18592
 Fatigue management for the A-7P p 79 A92-18593
 ETOPS: A developing scene [PNR-90844] p 98 A92-20459
- Survey of French activities concerning structural airworthiness and aging aircraft p 57 A92-30130
 A background to the handling qualities of aircraft [ESDU-92006] p 109 A92-32780
- AIRCRAFT RUNUP**
 Heavy metal --- fighter aircraft test rigs p 110 A92-18100
- AIRCRAFT SAFETY**
 Damping down the fires --- in civil transport aircraft p 53 A92-25075
 Security rights in aircraft under Belgian law p 280 A92-35589
 Ageing airliner census - Still flying safely p 54 A92-38374
 Windscreens departure p 55 A92-42500
 Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548
 CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549
 A review of UK aviation policy [TT-9107] p 5 A92-12988
 Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 A92-14007
 The Operational Loads Monitoring System, OLMS p 79 A92-18586
 Aircraft fatigue management in the Royal Air Force p 79 A92-18591
 An evaluation of in-cabin safety features in passenger aircraft [ETN-92-90656] p 55 A92-20794
 Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 A92-21679
- AIRCRAFT STABILITY**
 Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia --- aircraft models applied to real aircraft p 217 A92-12346
 Robust flight control systems - A parameter space design p 106 A92-50503
 Aircraft aerodynamics and stability and control during air-to-air refueling [AERO-REPT-9017] p 107 A92-18321
 Vortex flow aerodynamics [AGARD-AR-299] p 50 A92-30947
- AIRCRAFT STRUCTURES**
 Fatigue and damage tolerance verification of aircraft structures p 217 A92-19677
 Structural optimization at Aerospatiale Aircraft [AIAA PAPER 92-2371] p 256 A92-34542
 Aircraft structural design p 72 A92-39304
 The evolution from bonded F27 aircraft to Arall structures p 3 A92-41177
 Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
 Effects of spectrum variations on fatigue crack growth p 219 A92-57399
 Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 A92-14042
 Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 A92-17310
 Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 A92-18244
 Fatigue safety factor: Assessment of associated safety level p 220 A92-18573
 Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 A92-18574
 Fatigue life behaviour of composite structures p 145 A92-18577
 Aircraft tracking optimization of parameters selection p 79 A92-18585
 Aircraft fatigue management in the Royal Air Force p 79 A92-18591
 Tornado structural fatigue life assessment of the German Air Force p 79 A92-18592
 Fatigue management for the A-7P p 79 A92-18593
 Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 A92-22000
 Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 A92-23227
 Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 A92-23233
 First approach to an integrated fin design p 83 A92-23236
 Structural optimization of aircraft practice and trends p 83 A92-23239
- Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-LS-186] p 85 A92-28469
 Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 A92-28471
 Structural optimization of aircraft p 86 A92-28472
 Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 A92-29650
 MBB-LAGRANGE: A general structural reliability and optimization structural system p 220 A92-30423
 [MBB/FW321/S/PUB/467] p 220 A92-30423
 Multidisciplinary optimization of fiber composite aircraft structures p 87 A92-30424
 [MBB/FW321/S/PUB/476] p 87 A92-30424
 Analysis of three icing test flights reaching the aircraft-referred icing degree of severe [ESA-TT-1254] p 58 A92-31943
 Aspects of compression in aerospace composites: Future requirements p 146 A92-33036
 Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 A92-33048
 Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 A92-33694
- AIRCRAFT SURVIVABILITY**
 Real-time mechanisms in a multibase knowledge system p 264 A92-20345
 Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301
- AIRCRAFT WAKES**
 On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 A92-13021
 Numerical simulation of vortex flows past impulsively started wings p 33 A92-13028
- AIRFIELD SURFACE MOVEMENTS**
 Madrid's double airport p 110 A92-16231
 A Taxi And Ramp Management And Control system (TARMAC) p 113 A92-14027
 Testing concept of a movement area guidance p 65 A92-25597
- AIRFOIL OSCILLATIONS**
 Dynamic characterization and identification of nonlinear systems application to aeronautical structures p 217 A92-11830
 Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
 An experiment on unsteady flow over an oscillating airfoil [ASME PAPER 91-GT-181] p 8 A92-15613
 The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
 Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
 Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program [PB92-138676] p 53 A92-70590
- AIRFOIL PROFILES**
 Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
 Solution of the Reynolds-averaged Navier-Stokes equations for transonic airfoil flows p 6 A92-13198
 Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model p 11 A92-23803
 A note on the Kutta condition in Glauert's solution of the thin airfoil problem p 16 A92-37933
 Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
 Computer simulation of an unsteady flow around an airfoil with a spoiler p 19 A92-43167
 Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions [AIAA PAPER 92-2638] p 20 A92-45507
 The design and testing of an airfoil with hybrid laminar flow control [ONERA, TP NO. 1992-22] p 24 A92-48585
 A review of scale effects in unsteady aerodynamics p 24 A92-50121
 Effect of a deicing device on the induced drag of a lifting airfoil p 74 A92-51947
 A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028
 Resolution of Navier-Stokes equations around profiles: Drag evolution [ONERA-RTS-86/1685-AY-156A] p 186 A92-11310

- Review of aerodynamic design in the Netherlands
p 76 N92-13929
- A method of estimating a flow breakdown boundary for
aerofoils and swept wings in transonic flows
[ESDU-91021] p 39 N92-15970
- AIRFOILS**
- An experimental investigation of the oblique blade-vortex
interaction p 19 A92-43447
- Prediction of the viscous transonic aerodynamic
performance of supercritical aerofoil sections
[AIAA PAPER 92-2653] p 21 A92-45569
- Calculation of potential flow around airfoils using a
discrete vortex method p 21 A92-45827
- Effect of model cooling on periodic transonic flow
p 22 A92-46900
- 3-D numerical grid generation for the transonic flow
analysis about multi-bodies p 22 A92-47061
- Application of direct inverse analogy method (DIVA) and
viscous design optimization techniques p 33 N92-13951
- Excrescence drag magnification factors at the drag-rise
condition for aerofoils with a specified form of
upper-surface pressure distribution
[ESDU-91029] p 39 N92-15973
- Aerodynamic effects of de/anti-icing fluids and
description of a facility and test technique for their
assessment p 56 N92-21697
- Improved shock-capturing of Jameson's scheme for the
Euler equations
[PB92-148758] p 196 N92-23251
- Computations of unsteady flows around airfoil sections
by explicit and implicit methods solving the Euler and
Navier-Stokes equations p 46 N92-27948
- Computation of unsteady turbulent boundary layer
effects on unsteady flow about airfoils
[PB92-138569] p 206 N92-70561
- AIRFRAME MATERIALS**
- Modern helicopter technologies at MBB and the
application in future programmes p 4 A92-56304
- AIRFRAMES**
- Airframe noise p 268 N92-10605
- Probabilistic design and fatigue management based on
probabilistic fatigue models with reliability updating
p 78 N92-18574
- The Operational Loads Monitoring System, OLMS
p 79 N92-18586
- AIRLINE OPERATIONS**
- A constraint satisfaction approach to operative
management of aircraft routing p 54 A92-25181
- Eurocontrol - UK detention rights p 280 A92-33048
- The bullish bear --- airline operations decentralization
in the Commonwealth of Independent States
p 2 A92-36350
- Aviation meteorology p 237 A92-38383
- Industrial practice in aeronautical maintenance
p 3 A92-47774
- Terminal area traffic management p 61 A92-50122
- A review of UK aviation policy
[TT-9107] p 5 N92-12988
- Drag reduction: An industrial challenge
p 44 N92-27708
- European studies to investigate the feasibility of using
1000 ft vertical separation minima above FL 290. Part 1:
Overview of organisation, techniques employed, and
conclusions
[NLR-TP-91062-U-PT-1] p 66 N92-29605
- AIRPORT PLANNING**
- Madrid's double airport p 110 A92-16231
- Airport terminals p 110 A92-21125
- Determination of aircraft noise levels while the engine
is running on the ground - An approach from the point of
urbanization and architecture p 227 A92-39064
- AIRPORTS**
- The view from the airport p 60 A92-33438
- Noise from military airfields in the United Kingdom
p 226 A92-39052
- Airport noise contours - Converting from NNI to Leq
p 227 A92-39053
- Aircraft noise - The calculation of the noise exposure
by aircraft in the Netherlands p 227 A92-39054
- DANSIM - Danish Airport Noise Simulation Model - Basic
principles, experience, and improvements p 227 A92-39055
- Airport technology international 1992
p 111 A92-39514
- A review of UK aviation policy
[TT-9107] p 5 N92-12988
- Trial of a slant visual range measuring device
p 210 N92-31043
- AIRSHIPS**
- Sentinel 1000 flight test programme overview and
preliminary results
[AIAA PAPER 92-1229] p 69 A92-33326
- The design challenge of a long endurance airship
[AIAA PAPER 92-1266] p 69 A92-33344
- Aerostat for the Mars 1994/1996 mission
p 285 N92-24642
- AIRSPACE**
- No end to incidents in airspace? III p 53 A92-23172
- COMPAS system concept p 63 N92-19043
- AIRSPEED**
- Theoretical simulation of a 2 micron airborne solid state
laser anemometer p 210 N92-31059
- ALBEDO**
- Remote sensing of seasonal variations in albedo over
southern Britain p 241 N92-33969
- ALGAE**
- Application of aircraft multispectral scanner data to algae
mapping over the Venice Lagoon p 221 A92-17104
- ALGEBRA**
- Formal specification of satellite telemetry: A practical
experience p 129 N92-12456
- ALGORITHMS**
- Simulation of hypersonic flows on unstructured grids
p 15 A92-31496
- An unstructured mesh generation algorithm for
three-dimensional aeronautical configurations
p 262 A92-47053
- Four-dimensional data assimilation - Comparison of
variational and sequential algorithms p 239 A92-51783
- Resolution of the Navier-Stokes equations applied to
the computation of the laminar flow around a two
dimensional wing profile
[CERT-RT-65/5604-35] p 185 N92-11307
- Formal verification of a redundancy management
algorithm p 257 N92-12457
- Project of an adaptive multi-axial autopilot with learning
pilot control
[ETN-92-90592] p 107 N92-15072
- Parallel and vector aspects of a multigrid Navier-Stokes
solver
[PB91-232868] p 260 N92-16645
- VISIAN: A Viscous-Inviscid Strong-Interaction Analysis
System
[NLR-TR-88081-U] p 192 N92-18323
- Evaluation of the COMPAS experimental system
p 63 N92-19044
- Robust control system design with application to high
performance helicopters p 108 N92-19621
- Some aspects of shock capturing methods for gas
dynamics
[CRANFIELD-AERO-9112] p 192 N92-19916
- Marco contract report
[ETN-92-91077] p 193 N92-20232
- MATGRID: A program for generation of C-H and C-O
topology grids around wing/body configurations.
Mathematical/Definition document
[FFA-TN-1990-19] p 41 N92-20468
- Three-dimensional simulations of hypersonic flows
[MBB-UK-0155-89-PUB] p 42 N92-21703
- Object oriented hardware simulation of spacecraft
control algorithms p 259 N92-24487
- On the computation of unsteady turbomachinery flows.
Part 1: Euler equations in vibrating cascades
p 198 N92-27460
- Computation and visualization of specific flow
phenomena in turbomachinery application
p 100 N92-27463
- Unsteady Euler calculations in 3D internal
aerodynamics p 199 N92-27470
- A frontal approach for node generation in Delaunay
triangulations p 201 N92-27680
- Fundamentals of structural optimisation
p 86 N92-28470
- Quasi-recursive dynamics equations for
spacecraft-based flexible robotic manipulators
[NLR-TP-90028-U] p 261 N92-28648
- Wave drag determination in the transonic full-potential
flow code MATRICS
[NLR-TP-90062-U] p 47 N92-28709
- A multigrid method for a discretization of the
incompressible Navier-Stokes equations in general
coordinates
[REPT-91-73] p 203 N92-30454
- ALLOYING**
- MA alloys for aerospace applications --- Mechanical
Alloying p 149 A92-26128
- ALPINE METEOROLOGY**
- Comments on 'Large-eddy simulation of the up-slope
boundary layer' by Ulrich Schumann (April 1990, 116,
637-670) p 236 A92-27800
- ALTERNATING DIRECTION IMPLICIT METHODS**
- An unfactored implicit scheme for 3D inviscid transonic
flows
[AIAA PAPER 92-2668] p 20 A92-45523
- ALTITUDE CONTROL**
- European studies to investigate the feasibility of using
1000 ft vertical separation minima above FL 290. Part 1:
Overview of organisation, techniques employed, and
conclusions
[NLR-TP-91062-U-PT-1] p 66 N92-29605
- ALUMINIDES**
- Corrosion damage and regeneration of aluminide
coatings on aircraft turbine blades p 148 A92-15244
- ALUMINUM**
- The control of interface and microstructure of SiC/Al
composites by sol-gel techniques p 143 A92-20083
- ALUMINUM ALLOYS**
- Aerospace Alral - A challenge for the aircraft designer
p 143 A92-10232
- Corrosion damage and regeneration of aluminide
coatings on aircraft turbine blades p 148 A92-15244
- Welding of Ti 6Al 4V using a high power solid state
laser with fibre delivery p 210 A92-22773
- Introduction to metal matrix composites and a review
of their potential uses p 144 A92-45336
- Aluminides modified by palladium - Protection of new
parts by local finishing
[ONERA, TP NO. 1992-49] p 149 A92-48610
- Bulging of fatigue cracks in a pressurized aircraft
fuselage
[LR-655] p 77 N92-14045
- Crack resistance, fracture toughness and instability in
damage tolerant Al-Li alloys
[NLR-TP-90172-U] p 220 N92-28850
- Short cracks and durability analysis of the Fokker 100
wing/fuselage structure
[NLR-TP-90336-U] p 220 N92-29603
- Low-velocity impact loading on fibre reinforced aluminum
laminates (ARALL) and other aircraft sheet materials
[ETN-92-91613] p 146 N92-30414
- New accelerated corrosion test methods
[MBB-Z-0406-91-PUB] p 150 N92-32895
- ALUMINUM-LITHIUM ALLOYS**
- A study of reversion behaviour in 8090 alloys using small
angle neutron scattering and transmission electron
microscopy p 149 A92-25026
- Damage tolerance and durability evaluation of
aluminum-lithium alloys
[PB91-219477] p 150 N92-70307
- AMMUNITION**
- Interdiction mission planning and co-ordination during
the Gulf conflict 17 January - 27 February 1991
p 264 N92-27888
- AMORPHOUS MATERIALS**
- Environmental resistance of amorphous bonded
thermoplastic joints p 146 N92-33053
- ANALYTIC FUNCTIONS**
- Application of holomorphic vectors theory in
three-dimensional potential flow problem
p 165 A92-21923
- ANEOCHOIC CHAMBERS**
- Wall pressure wavenumber-frequency spectrum
beneath a turbulent boundary layer measured with
transducer arrays calibrated with an acoustical method
[ONERA, TP NO. 1991-212] p 13 A92-26364
- Acoustic characteristics of anechoic chamber at FFA
[FFA-TN-1990-43] p 268 N92-12599
- Definition of acoustic measurements in the anechoic
chamber of Palaiseau (France) and the wind tunnel at
Nantes (France)
[ONERA-RT-16/3641-PY] p 269 N92-20387
- ANEMOMETERS**
- Study of interactions on anemoclinometric sensors
[REPT-90/30] p 113 N92-12006
- ANGLE OF ATTACK**
- The evaluation of canard couplings at high angles of
attack
[AIAA PAPER 92-0281] p 12 A92-25735
- Numerical investigation into high-angle-of-attack
leading-edge vortex flow
[AIAA PAPER 92-2600] p 20 A92-45477
- Experimental investigation of vortex dynamics on delta
wings
[AIAA PAPER 92-2731] p 21 A92-45565
- Rarefied gas flow around a disc with different angles
of attack p 25 A92-52753
- Monte Carlo simulation of the hypersonic mon- and
diatomic gas flow past a disk at an angle of attack
p 25 A92-52770
- Control of forebody vortices by suction at the nose of
the RAE high incidence research model
p 32 N92-13022
- Hypersonic flow past delta wing flow simulated by
Navier-Stokes solutions p 34 N92-14981
- Contribution of fin and tailplane to sideforce and yawing
moment derivatives due to sideslip at supersonic speeds
at low angles of attack
[ESDU-91031] p 39 N92-15971

- Aerodynamic development of the X-31 aircraft for the high angle of attack region
[MBB-FE211-S-PUB-452] p 77 N92-17313
- Model incidence measurement using SAAB ELOPTOPOS system
[NLR-TP-89182-U] p 115 N92-18416
- Manoeuvring Aerodynamics
[AGARD-CP-497] p 80 N92-18778
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
- Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782
- Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 N92-18786
- Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
- X-31: Discussion of steady state and rotary derivatives p 81 N92-18789
- Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft
[NLR-TP-90087-U] p 108 N92-20475
- Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds
[ESDU-91042] p 84 N92-24009
- ANGLES (GEOMETRY)**
- Feasibility study of hypersonic clinometric measurements at R3Ch
[ONERA-RSF-136/1865-AY-728-] p 48 N92-28789
- ANGULAR ACCELERATION**
- Blade instability of horizontally stoppable rotors p 106 N92-56308
- ANGULAR MOMENTUM**
- Dynamics of spacecraft p 123 N92-33404
- ANISOTROPY**
- Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
[PB92-142421] p 273 N92-22738
- ANNUAL VARIATIONS**
- Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969
- ANNULAR FLOW**
- Calculations of the dilution system in an annular gas turbine combustor p 170 N92-31164
- Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors
[VKI-TN-178] p 269 N92-21237
- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- ANNULI**
- The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation
[PNR-90791] p 194 N92-22099
- ANTARCTIC REGIONS**
- Antarctic studies of the cusp p 233 N92-26301
- Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
- ANTENNA DESIGN**
- Electronically steerable antenna for aircraft p 156 N92-15272
- ANTENNA RADIATION PATTERNS**
- Radiation and coupling between antennas mounted on a complex metallic structure p 155 N92-42315
- ANTENNAS**
- SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- ANTIgravity**
- Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000
- APEXES**
- Cell vertex methods for compressible gas flows p 197 N92-26599
- APPLICATION SPECIFIC INTEGRATED CIRCUITS**
- Applications of ASICs to avionics
[AGARD-AG-329] p 92 N92-28376
- APPLICATIONS PROGRAMS (COMPUTERS)**
- Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
- Numerical simulation of vortex street-edge interaction p 33 N92-13027
- Mikado: A graphic program p 190 N92-16237
- Prediction of far-field harmonic noise from propellers
[ESDU-91033] p 269 N92-18074
- Modernized MBB panel code: User's guide including background theory
[PB92-136431] p 43 N92-22233
- APPROACH**
- Effective cueing during approach and touchdown: Comparison with flight p 117 N92-28552

APPROACH CONTROL

- The new airport aeronautical meteorological codes p 235 N92-13855
- Results of a test program for the use of differential GPS for approach guidance p 59 N92-16969
- DME growth elements and their use with MLS p 62 N92-14018
- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
- The COMPAS system in the ATC environment
[DLR-MITT-91-08] p 62 N92-19041
- Design principles of automation aids for ATC approach control p 62 N92-19042
- COMPAS system concept p 63 N92-19043
- Evaluation of the COMPAS experimental system p 63 N92-19044
- Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
- Steps toward acceptance p 63 N92-19046
- Evaluation of the COMPAS operational system p 63 N92-19047
- Extension of the Frankfurt COMPAS for general application p 63 N92-19048
- The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049
- Approach and landing assisted by onboard image processing p 64 N92-21959
- Approach and landing guidance p 65 N92-21960
- Development of new flight procedures for the Microwave Landing System (MLS)
[NLR-TP-91156-U] p 66 N92-32830
- APPROACH INDICATORS**
- Infra-red offers new landing aid competition p 88 N92-18937
- APPROXIMATION**
- Numerical simulation of two-dimensional flows by the free-Lagrangian method
[TUM-M9105] p 204 N92-32767
- AQUIFERS**
- Flow of fresh and salt water in an aquifer with injection from the top
[REPT-91-68] p 203 N92-30453
- ARAMID FIBER COMPOSITES**
- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 N92-42142
- ARC HEATING**
- Rotational temperature measurements in an arc jet p 177 N92-44395
- Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
- ARC JET ENGINES**
- Plasma thruster development program at the IRS
[IAF PAPER 92-0610] p 141 N92-57061
- ARCHITECTURE**
- Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 N92-39064
- ARCHITECTURE (COMPUTERS)**
- Architecture and interconnects of programmable processors of radar signals p 159 N92-23042
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow
[ONERA, TP NO. 1991-196] p 255 N92-26355
- From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot
[ONERA, TP NO. 1991-216] p 260 N92-26368
- Transmission vibration monitoring - A single board computer architecture p 89 N92-35765
- ARINC and the avionics of commercial aircraft. II p 60 N92-37072
- Flight management system back-up navigation for the A330/A340 aircraft p 106 N92-49326
- Mixed approach towards modular avionics conflicting requirements p 91 N92-14051
- Avionics software evolution p 91 N92-14052
- Three-dimensional computer graphics in flow visualization p 189 N92-16227
- Application of VME-technology on an airborne data link processor unit
[NLR-MP-88040-U] p 66 N92-29615
- ARCTIC OCEAN**
- Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge
[AD-A241072] p 232 N92-13512
- ARCTIC REGIONS**
- Polar lows and arctic instability lows in the Bear Island region p 237 N92-32490

- Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances p 232 N92-55441
- An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 N92-17169
- A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
- The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
- Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- ARGOS SYSTEM**
- Accurate current measurement using drogued buoys employing Decca Navigator and Argos p 241 N92-12278
- ARIANE LAUNCH VEHICLE**
- Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 N92-53774
- A research and technology program for the benefit of the Ariane family
[IAF PAPER 92-0873] p 127 N92-57262
- Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 N92-15040
- Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber) p 142 N92-18636
- Design evolution of the Ariane launching installations p 126 N92-20726
- Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- Dynamic load cases on Ariane 5 p 127 N92-23797
- LARVE: A hypersonic flight test facility launched by Ariane 4
[PB92-138726] p 118 N92-70983
- ARMED FORCES (FOREIGN)**
- Aircraft fatigue management in the Royal Air Force p 79 N92-18591
- ARRHYTHMIA**
- Cardiological aspects of pilot's fitness to fly p 245 N92-16406
- ARTIFACTS**
- Air museum p 283 N92-25761
- ARTIFICIAL GRAVITY**
- Critical technologies: Spacecraft habitability, an update p 254 N92-27010
- ARTIFICIAL INTELLIGENCE**
- ACLICO: An aid system for designing bonded joints
[REPT-911-430-134] p 152 N92-12146
- Machine Intelligence for Aerospace Electronic Systems
[AGARD-CP-499] p 261 N92-12517
- Development of tactical decision aids p 90 N92-12532
- Integrating machine intelligence into the cockpit to aid the pilot p 252 N92-12533
- ARTIFICIAL SATELLITES**
- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
- Fuzzy guidance system evaluation p 259 N92-27903
- ASCENT TRAJECTORIES**
- Control models for ascent performance optimization of airbreathing launch vehicles p 124 N92-53645
- ASPECT RATIO**
- Effect of two fins on isolated tailplane lift-curve slope
[ESDU-91009] p 28 N92-11969
- Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
- A theoretical investigation of the induced drag of wing of finite aspect ratio
[CUED/A-AERO/TR-17(1991)] p 43 N92-22193
- ASSEMBLING**
- Assembling the future p 3 N92-44895
- ASSESSMENTS**
- Why is space software special? p 258 N92-20626
- ASSURANCE**
- Quality assurance requirements for ESA space systems
[ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- ASTROLOGY (TRADEMARK)**
- Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 N92-19767
- ASTROMETRY**
- Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990
[ETN-92-91068] p 287 N92-24351
- ASTRONAUT TRAINING**
- Analogy between training for dancers and problems of adjustment to microgravity - An evaluation of the subjective vertical in dancers
[IAF PAPER 90-653] p 245 N92-12125

- Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- ASTRONAUTICS**
Some new definitions for the Multilingual Terminology Data Base [IAF PAPER 92-0359] p 277 A92-55766
- ASTRONAUTS**
'Space objects', 'astronauts', and related expressions p 281 A92-51854
Multi-cultural components and keys for European worldwide space programs p 122 N92-27008
- ASTRONOMICAL MODELS**
Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523
- ASYMMETRY**
Asymmetric vortex flow over circular cones p 32 N92-13014
- ASYMPTOTIC METHODS**
A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
Asymptotic techniques for the analysis of fluid systems p 163 A92-16229
Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
Axisymmetric laminar interacting boundary layers p 176 A92-42534
Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
- ASYMPTOTIC PROPERTIES**
Playing with nonuniform grids p 172 A92-37936
- ATLANTIC OCEAN**
An investigation of cold overflow over the Iceland/Faeroes Ridge [AD-A243084] p 242 N92-17169
- ATMOSPHERIC ATTENUATION**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
- ATMOSPHERIC BOUNDARY LAYER**
Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
Sodar wind speed profiles over forested boundary layer during the Hapex-Mobility campaign p 235 A92-17729
Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054
Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093
Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge [AD-A241072] p 232 N92-13512
Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 N92-19292
The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- ATMOSPHERIC CHEMISTRY**
Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541
- ATMOSPHERIC CIRCULATION**
Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902
Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
The Venusian polar dipole p 285 A92-30456
Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
The effects of resolution on diagnostic calculations of coupling between radiation and dynamics p 238 A92-47734
Four-dimensional data assimilation - Comparison of variational and sequential algorithms p 239 A92-51783
Local error growth in a barotropic model p 239 A92-52941

- The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model --- of trace elements in middle atmosphere p 239 A92-53349
The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
Tracer transport in the middle atmosphere p 229 N92-26473
- ATMOSPHERIC COMPOSITION**
Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541
Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
Tracer transport in the middle atmosphere p 229 N92-26473
Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- ATMOSPHERIC CORRECTION**
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
TIMS calibration correction by comparison with PRT5 p 223 N92-11412
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
- ATMOSPHERIC DENSITY**
The upper atmosphere as sensed by satellite orbits p 230 A92-30638
- ATMOSPHERIC EFFECTS**
Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 A92-39064
- ATMOSPHERIC ELECTRICITY**
Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678
- ATMOSPHERIC ENTRY**
Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
Atmospheric re-entry p 123 A92-33409
Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764
Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 N92-12065
Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 N92-20477
- ATMOSPHERIC ENTRY SIMULATION**
Simulation of hypersonic flows on unstructured grids p 15 A92-31496
Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
- ATMOSPHERIC GENERAL CIRCULATION MODELS**
Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
- ATMOSPHERIC HEATING**
Reduction of target scattering by tropospheric modification p 157 N92-19164
Tracer transport in the middle atmosphere p 229 N92-26473
- ATMOSPHERIC MODELS**
Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
Local error growth in a barotropic model p 239 A92-52941
The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
Visualization of instationary flows by particle traces p 189 N92-16234
Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
Tracer transport in the middle atmosphere p 229 N92-26473
On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 N92-29703
- ATMOSPHERIC MOISTURE**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
In situ measurements of the ice water content in cirrus clouds p 236 A92-22952

- ATMOSPHERIC OPTICS**
Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645
- ATMOSPHERIC PHYSICS**
Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
- ATMOSPHERIC PRESSURE**
A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489
Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
Polar lows affecting Denmark p 237 A92-32491
- ATMOSPHERIC REFRACTION**
Reduction of target scattering by tropospheric modification p 157 N92-19164
- ATMOSPHERIC SOUNDING**
Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902
Use of relative humidity sensors for planes measurement p 89 A92-32080
A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340
- ATMOSPHERIC STRATIFICATION**
Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800
- ATMOSPHERIC TEMPERATURE**
A new thermometric instrument for airborne measurements in clouds p 88 A92-24918
A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489
A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284
- ATMOSPHERIC TURBULENCE**
International standardisation of regulations for gust loading calculations p 68 A92-22473
Gust effects on a flexible aircraft p 68 A92-22474
Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363
Selected models of aircraft navigation space p 61 A92-45373
The role of diffusive effects on potential vorticity fronts p 238 A92-51781
ATTAS flight test and simulation results of the advanced gust management system LARS [AIAA PAPER 92-4343] p 106 A92-55332
Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 N92-19292
Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
Atmospheric turbulence spectra and correlation functions [NLR-TP-89217-U] p 234 N92-28689
Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
- ATMOSPHERIC WINDOWS**
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- ATOMIZING**
Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208
- ATTACK AIRCRAFT**
Rafale: Program update - Development of a naval version p 72 A92-40035
Rapidly going nowhere? --- combat aircraft development in Russia p 74 A92-54545
An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994

ATTITUDE (INCLINATION)

Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028

ATTITUDE CONTROL

A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
Near-field expansion in thruster plumes p 141 A92-52799

Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
Design aspects of the attitude control system for the SOHO spacecraft p 135 N92-24433
The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445

Low cost spacecraft attitude sensors p 140 N92-24458
Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474

Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
The dynamics of the Cluster spacecraft p 137 N92-24510

Fuzzy guidance system evaluation p 259 N92-27903

ATTITUDE INDICATORS

Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
Low cost spacecraft attitude sensors p 140 N92-24458

ATTITUDE STABILITY

On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499

AUDIO FREQUENCIES

Do we really need 57 ways of rating aircraft noise? p 227 A92-39065

AUDITORY DEFECTS

Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241

AUDITORY PERCEPTION

NATO CCMS aircraft noise study on receiver technology p 226 A92-39050

AUGER SPECTROSCOPY

Applications of ultra-high vacuum technique to surface and near-surface studies [ETN-92-90454] p 147 N92-14141

AURORAS

Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089
The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295

AUSTRALIAN SPACE PROGRAM

Australian space - Looking for a direction p 120 A92-36073

AUTOGYROS

An aerodynamical analysis of 'seesaw' type rotor for autogyro p 24 A92-52034

AUTOMATED EN ROUTE ATC

Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290

AUTOMATED RADAR TERMINAL SYSTEM

The European ATC challenge p 58 A92-11877

AUTOMATIC CONTROL

Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 N92-12517
Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313

Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 N92-19932

Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
Concurrent engineering p 260 N92-30952
Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 N92-32229

AUTOMATIC FLIGHT CONTROL

Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322

AUTOMATIC LANDING CONTROL

Approach and landing assisted by onboard image processing p 64 N92-21959

AUTOMATIC PILOTS

Project of an adaptive multiaxial autopilot with learning pilot control [ETN-92-90592] p 107 N92-15072

AUTOMATIC TEST EQUIPMENT

A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323

AUTOMATION

Pilot attitudes to cockpit automation p 250 A92-44926
Design principles of automation aids for ATC approach control p 62 N92-19042

AUTONOMOUS NAVIGATION

Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473
Operational aspects of spacecraft autonomy p 131 A92-24207

AUTONOMY

Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601

AUXILIARY POWER SOURCES

The engine inside p 94 A92-36126

AVAILABILITY

Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber) [MBB-UK-0144-PUB] p 142 N92-18636
Reliability, availability, maintainability, and safety p 216 N92-18639
RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 N92-18647

AVIATION METEOROLOGY

Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291
The new airport aeronautical meteorological codes p 235 A92-13855
Aviation meteorology p 237 A92-38383
Shear progress --- wind shear handling and recognition technologies for aviation p 3 A92-40880
Commission for Aeronautical Meteorology. Abridged final report of the ninth session [WMO-752] p 240 N92-18911
Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679
Flight in adverse environmental conditions p 55 N92-21680

AVIATION PSYCHOLOGY

A conceptualization of aviation psychology on the civil flight deck p 250 A92-13849
Pilot attitudes to cockpit automation p 250 A92-44926
The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994
Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 N92-13547
The pilot flight surgeon bond p 250 N92-13548
Aviation psychology in the operational setting p 250 N92-13550

AVIONICS

Flying the A340 iron bird p 67 A92-10666
Requirements and possible technical solutions derived from the new air mobility concept of the German Army p 1 A92-14348
Clever cockpits p 1 A92-21700
High costs force avionics links p 88 A92-22000
Anglo-American avionics p 2 A92-25575
ARINC and commercial aircraft avionics. I p 60 A92-25655
From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368
Test Engineering Language for Avionic Systems p 89 A92-35763
ARINC and the avionics of commercial aircraft. II p 60 A92-37072
ELS for the A340 --- Electronic Library System [SAE PAPER 91-2111] p 89 A92-39963
Through the looking glass --- effectiveness of electronic flight instrument systems p 90 A92-46449
Is the avionics system of the Hermes Spaceplane centralized or decentralized? p 139 A92-49258
Test and integration concept for complex helicopter avionic systems p 90 A92-56292
Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
Military and civil software standards and guidelines for guidance and control p 257 N92-12452

Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 N92-12517
Development of tactical decision aids p 90 N92-12532

Expert system for the Tornado ground-based check-out system p 91 N92-12536
The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 N92-14046

Avionics standardization in Europe p 91 N92-14050
Mixed approach towards modular avionics conflicting requirements p 91 N92-14051
Avionics software evolution p 91 N92-14052
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 N92-14054
Implications of interoperability and standardization for the industrial base p 92 N92-14057
Validation of flight critical control systems [AGARD-AR-274] p 108 N92-20026
Space software is first of all software p 258 N92-20590

Flight test of avionic and air-traffic control systems [ETN-92-91063] p 65 N92-25590
Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600

Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603
A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895

Applications of ASICs to avionics [AGARD-AG-329] p 92 N92-28376
Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379

Integrated Target Acquisition and Fire Control Systems [AGARD-CP-500] p 92 N92-32437

AXIAL FLOW

Design and performance of advanced blading for a high-speed HP compressor p 9 A92-15718
[ASME PAPER 91-GT-374] p 9 A92-15718
The multiparameter method of a boundary layer on thin bodies of revolution p 165 A92-21613
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
Experimental examination of heavily loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926

AXIAL FLOW TURBINES

An Axial Turbopump [ASME PAPER 91-GT-1] p 211 A92-15501
Turbulence modelling for secondary flow prediction in a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535
3-D loss prediction based on secondary flow and blade shear layer interaction [ASME PAPER 91-GT-59] p 7 A92-15536
Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457

AXISYMMETRIC BODIES

Base bleed technology in perspective p 17 A92-39427
Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 N92-11967
Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds [ESDU-91042] p 84 N92-24009
An investigation into the interface between three closely spaced axi-symmetric bodies at subsonic speed [CRANFIELD-AERO-9114] p 50 N92-31514
Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 N92-32479

AXISYMMETRIC FLOW

Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
An approximate method for treating a turbulent boundary layer with symmetry of revolution p 164 A92-21306

- Axisymmetric laminar interacting boundary layers
p 176 A92-42534
- Impingement of an axisymmetric jet on unheated and heated flat plates
p 182 A92-50297
- Organized structures in the developing region of axisymmetric jet flow
p 182 A92-51892
- Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique
p 26 A92-54308
- Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream
p 183 A92-54963
- Flow computation in combustion chambers using zonal nonstaggered grids
p 200 A92-27483

B**BACILLUS**

- Long-term exposure of bacterial spores to space
p 244 A92-27126

BACKSCATTERING

- Charged dust in the earth's mesopause - Effects on radar backscatter
p 231 A92-41800
- Airborne lidar and radiometric observations of PBL and low clouds
p 240 A92-31037

BACTERIA

- Thiobacillus roseopersicina*, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes
p 244 A92-26977

BALANCING

- Symposium on dynamic balancing
p 221 A92-71104

BALLISTIC MISSILES

- Determination of the aerodynamic flow about a reentry body at high altitude
p 14 A92-28975

BALLISTIC TRAJECTORIES

- Computer codes for ballistic performance calculations of base bleed propellant grain
p 17 A92-39433

BALLOON FLIGHT

- Aerostat for the Mars 1994/1996 mission
p 285 A92-24642
- The concept of a long duration stratospheric balloon
p 43 A92-24645

BALLOON SOUNDING

- The Norwegian sounding rocket and balloon programme
p 122 A92-24594

BALLOON-BORNE INSTRUMENTS

- The Norwegian sounding rocket and balloon programme
p 122 A92-24594
- Balloons for conjugate cusp studies in the 1990's
p 233 A92-26315

BALLOONS

- Esrangle: Sounding rocket and balloon facility
p 126 A92-20720
- Balloon-borne drop capsule MIKROBA
p 152 A92-24617

BANDWIDTH

- Sensor compatibility/optimal sensor combinations
p 224 A92-23403

BAROCLINIC INSTABILITY

- The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves
p 166 A92-23292
- Polar lows and arctic instability lows in the Bear Island region
p 237 A92-32490
- Polar lows affecting Denmark
p 237 A92-32491
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 A92-28365

BAROCLINIC WAVES

- The enigmatic merging conditions of two-layer baroclinic vortices
p 162 A92-11225
- The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves
p 166 A92-23292
- The role of diffusive effects on potential vorticity in fronts
p 238 A92-51781
- Upper/lower vortex interaction and potential vorticity inversion
p 233 A92-26331

BAROTROPIC FLOW

- Local error growth in a barotropic model
p 239 A92-52941
- The stability of barotropic vortices: Implications for tropical cyclone motion
p 240 A92-26335

BARRIERS

- Analysis of wind tunnel dispersion data over two-dimensional obstacles
p 228 A92-42093
- Study of noise generated by the impingement of a hot supersonic jet on an obstacle
[ONERA, TP NO. 1992-33] p 267 A92-48594

BASE FLOW

- Base bleed technology in perspective
p 17 A92-39427
- Computer codes for ballistic performance calculations of base bleed propellant grain
p 17 A92-39433

BASE PRESSURE

- Base bleed technology in perspective
p 17 A92-39427
- Computer codes for ballistic performance calculations of base bleed propellant grain
p 17 A92-39433
- Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles
p 35 A92-14992

BAYES THEOREM

- Non-invasive detection of silent myocardial ischemia - A Bayesian approach
p 245 A92-16405

BED REST

- Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest
[IAF PAPER 91-550] p 246 A92-18547

BELGIAN SPACE PROGRAM

- USO concept in the member states - Belgium
p 119 A92-32466

BELGIUM

- The role of Belgium in Earth observation from space programs
p 229 A92-25245

BERYLLIUM ISOTOPES

- Surface activation of Concorde by Be-7
p 271 A92-23295

BIBLIOGRAPHIES

- List of reports, 1989
p 278 A92-71169
- List of reports, 1990
p 278 A92-71170

BINARY MIXTURES

- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS
p 197 A92-27027

BINOCULAR VISION

- Does the future lie in binocular helmet display?
p 253 A92-19019

BIOASTRONAUTICS

- Effects of long duration spaceflight on human T lymphocyte and monocyte activity
p 245 A92-15956
- Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest
[IAF PAPER 91-550] p 246 A92-18547
- Rib cage shape and motion in microgravity
p 247 A92-56944
- A history of the scientific study of living organisms in space
[IAF PAPER ST-92-0022] p 254 A92-57366

BIOMASS

- Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper
p 222 A92-37633
- Thiobacillus roseopersicina*, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes
p 244 A92-26977

BIOT METHOD

- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices
p 32 A92-13021

BIOTECHNOLOGY

- High performance capillary electrophoresis in microgravity environment
p 206 A92-20996
- Biotechnology in a global economy. Volume 2, part 1: Contractor documents
[PB91-212068] p 228 A92-13494

BLADE SLAP NOISE

- High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel
[ONERA, TP NO. 1991-124] p 9 A92-16102
- Influence of geometrical parameters on helicopter rotor high speed impulsive noise
[ONERA, TP NO. 1992-40] p 267 A92-48601

BLADE TIPS

- Lifting line predictions for a swept tip rotor blade
p 7 A92-14424
- High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel
[ONERA, TP NO. 1991-124] p 9 A92-16102
- Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors
[ONERA, TP NO. 1991-178] p 10 A92-16140
- Design and manufacturing of torsional flexible blade models
p 71 A92-35780
- The use of optical sensors and signal processing gas turbine engines
p 90 A92-46247
- Experimental and numerical study of flow around helicopter rotor blade tips
p 22 A92-46948

BLADE-VORTEX INTERACTION

- 3-D loss prediction based on secondary flow and blade shear layer interaction
[ASME PAPER 91-GT-59] p 7 A92-15536
- Theoretical study and prediction of BVI noise including close interactions
[ONERA, TP NO. 1991-174] p 265 A92-16138
- An experimental investigation of the oblique blade-vortex interaction
p 19 A92-43447
- Experimental and numerical study of flow around helicopter rotor blade tips
p 22 A92-46948

Progress towards quieter civil helicopters

- p 267 A92-52847
- BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW
p 268 A92-56344
- The turbomachine blading design using S2-S1 approach
p 97 A92-13940
- Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction
[ONERA-RS-97/5094-PY] p 269 A92-21736

BLASIUS EQUATION

- On the development of Goertler vortices in wall jet flow
p 177 A92-44801

BLASIUS FLOW

- The nonlinear stability of flows over compliant walls
p 179 A92-46265

BLAST LOADS

- Dynamic load cases on Ariane 5
p 127 A92-23797

BLOOD

- Blood lactate during leg exercise in microgravity
p 247 A92-50162

BLOOD FLOW

- G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension
p 248 A92-18984
- Circulatory biomechanics effects of accelerations
p 248 A92-18991
- Study of the loss of consciousness inflight by fighter aircraft pilots
[ONERA-RTS-11/3446-EY] p 249 A92-28844

BLOOD PRESSURE

- Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine
p 246 A92-39214
- Pulmonary effects of high-G and positive pressure breathing
p 248 A92-18978
- Control of blood pressure in humans under microgravity
p 248 A92-23071

BLOWDOWN WIND TUNNELS

- Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography
p 208 A92-54321
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements
[ETN-92-91492] p 49 A92-29889

BLOWERS

- Validation of a 3D Navier-Stokes code on experimental compressor bladings
[ONERA, TP NO. 1991-229] p 13 A92-26381

BLUFF BODIES

- Combustion calculations on a premixed system with a bluff body flameholder
[AIAA PAPER 92-3470] p 147 A92-49017
- The flow past bluff bodies by a vortex method
[AERO-REPT-9016] p 191 A92-18291
- Vorticity measurements in the near wake of a bluff body at low Reynolds numbers
[AERO-REPT-9102] p 195 A92-22100

BLUNT BODIES

- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures
p 31 A92-13005
- Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions
p 34 A92-14981
- Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers
[FFA-TN-1991-40] p 43 A92-23168

BO-105 HELICOPTER

- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3
p 84 A92-25591

BOATS

- Yacht sail aerodynamics. Part 3: Achievable jibsail specification
[ISBN-0-904947-17-3] p 52 A92-70513
- Yacht sail aerodynamics. Part 2: Achievable mainsail specification
[ISBN-0-904947-16-5] p 52 A92-70514

BODIES OF REVOLUTION

- The multiparameter method of a boundary layer on thin bodies of revolution
p 165 A92-21613
- Using Rankine vortices to model flow around a body of revolution
p 169 A92-28061
- Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow
p 31 A92-13010
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream
p 45 A92-27946

BODY-WING CONFIGURATIONS

- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft
p 71 A92-37074
- Lift-curve slope of wing-body combinations
[ESDU-91007] p 28 A92-11968
- Vortical flow simulation by using structured and unstructured grids
p 30 A92-12999

- Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000
On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003
- MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468
Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds [ESDU-91042] p 84 N92-24009
Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657
Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 N92-32479
- BOEING AIRCRAFT**
Delivered with feeling --- computer-based design of flight control system for Boeing 777 p 103 A92-16621
BA's 777 p 74 A92-51580
777 shaping up p 74 A92-52300
- BOEING 747 AIRCRAFT**
Mass-transporter p 69 A92-34650
- BOLTED JOINTS**
Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- BOLTZMANN TRANSPORT EQUATION**
The Harold Grad Lecture - Mathematics and the Boltzmann equation p 274 A92-52702
Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
Entropy production in gaseous boundary layers p 183 A92-52814
Transitional flows around re-entry bodies p 38 N92-15035
- BOMBING EQUIPMENT**
Improvement of separations of practice bombs from a multiple bomb adapter [NLR-TP-90307-U] p 86 N92-28634
Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
- BOMBS (ORDNANCE)**
Improvement of separations of practice bombs from a multiple bomb adapter [NLR-TP-90307-U] p 86 N92-28634
Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
- BONDING**
ACLICO: An aid system for designing bonded joints [REPT-911-430-134] p 152 N92-12146
- BOOLEAN ALGEBRA**
The avoidance of collisions for Newtonian bodies with hidden variables p 59 A92-24945
- BOOSTER ROCKET ENGINES**
Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 N92-27148
- BOOSTER ROCKETS**
Gosling --- British Defence System rocket motor p 286 A92-30101
- BOREDOM**
The development of a working model of flight crew underload p 249 A92-13019
- BORON CARBIDES**
Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292
- BOSONS**
Exotic states in the cores of quantized vortices for superfluids and superconductors [DE92-728466] p 206 N92-70151
- BOUNDARIES**
A frontal approach for node generation in Delaunay triangulations p 201 N92-27680
- BOUNDARY CONDITIONS**
Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCANE-T campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
Numerical computation of internal and external flows. Vol. 2 - Computational methods for inviscid and viscous flows --- Book [ISBN 0-471-92351-6] p 166 A92-22624
Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
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- Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
- A new automatic grid generation environment for CFD applications [AIAA PAPER 92-2720] p 21 A92-45558
An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124
The turbomachine blading design using S2-S1 approach p 97 N92-13940
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
Development and validation of a characteristic boundary condition for a cell-centered Euler method [NLR-TP-90144-U] p 47 N92-28692
Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712
Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TP-88072-U] p 49 N92-29884
Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions [PB92-138577] p 118 N92-70574
- BOUNDARY ELEMENT METHOD**
A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098
Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
On the analysis of liquid filled free-free tanks p 196 N92-23843
Hyperbolic grid generation with BEM source terms [NLR-TP-90334-U] p 264 N92-28635
- BOUNDARY INTEGRAL METHOD**
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
Applications of boundary integral methods to the study of steep free surface waves p 195 N92-23149
A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- BOUNDARY LAYER CONTROL**
The design and testing of an airfoil with hybrid laminar flow control [ONERA, TP NO. 1992-22] p 24 A92-48585
Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 N92-27706
Basic concepts on boundary layers p 44 N92-27707
Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711
Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201
- BOUNDARY LAYER EQUATIONS**
An approximate method for treating a turbulent boundary layer with symmetry of revolution p 164 A92-21306
The multiparameter method of a boundary layer on thin bodies of revolution p 165 A92-21613
Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 N92-17311
VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323
Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB-FE211/S-PUB/466] p 204 N92-30674
- BOUNDARY LAYER FLOW**
Impinging jets in cross-flow p 169 A92-28942
Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055
Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
Models of turbulence in a hypersonic boundary layer p 19 A92-41817
A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300
Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
Entropy production in gaseous boundary layers p 183 A92-52814
The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449
Airframe noise p 268 N92-10605
Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231
On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234
Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765
Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 N92-32776
Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- BOUNDARY LAYER SEPARATION**
Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815
Computations of a separated turbulent boundary layer p 174 A92-40131
Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
Separation and vortex formation in turbulent flows [ONERA, TP NO. 1992-7] p 24 A92-48579
Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210
Review of aircraft dynamic loads due to flow separation p 31 N92-13008
An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933
The 8th Symposium on Turbulent Shear Flows. Volume 2: 19-31, poster sessions. [AD-A243810] p 192 N92-18934
Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 N92-22209
- BOUNDARY LAYER STABILITY**
The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code [CERT-RT-63/5618-54] p 185 N92-11306
Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210

- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 N92-33996
- BOUNDARY LAYER TRANSITION**
- Steady and unsteady 3D interactive boundary layers p 161 A92-10689
- Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228
- Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code [CERT-RT-63/5618-54] p 185 N92-11306
- Control aspects of the transition from transversal to transonic flow, step effects [ETN-91-90106] p 29 N92-11981
- Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210
- Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215
- Hypersonic boundary layers: Transition and turbulence effects p 188 N92-14976
- Hypersonic wakes [ETN-92-91082] p 41 N92-19925
- Boundary layer transition on concave surfaces p 195 N92-22200
- Boundary Layers in Turbomachines [VKI-LS-1991-06] p 99 N92-24336
- Boundary layers and transition on concave surfaces p 196 N92-24341
- Numerical prediction of boundary layers and transitional flows p 196 N92-24342
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 N92-24343
- Basic concepts on boundary layers p 44 N92-27707
- Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711
- Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118
- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 N92-33996
- BOUNDARY LAYERS**
- Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800
- Organized structures in the developing region of axisymmetric jet flow p 182 A92-51892
- Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge [AD-A241072] p 232 N92-13512
- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution [ESDU-91029] p 39 N92-15973
- Sydney Goldstein FRS Hon FRAeS: An appreciation [AERO-REPT-8903] p 286 N92-17928
- Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784
- Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993
- Boundary layer transition on concave surfaces p 195 N92-22200
- Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 N92-22209
- Boundary Layers in Turbomachines [VKI-LS-1991-06] p 99 N92-24336
- Numerical prediction of boundary layers and transitional flows p 196 N92-24342
- Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201
- BOUNDARY VALUE PROBLEMS**
- Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 N92-15006
- Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation p 42 N92-22183
- Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712
- Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 N92-32734
- BRAIN CIRCULATION**
- G-LOC, Gz and brain hypoxia, Gz/s and intracranial hypertension p 248 N92-18984

- BRAKES (FOR ARRESTING MOTION)**
- An Axial Turbobrake [ASME PAPER 91-GT-1] p 211 A92-15501
- BRAZING**
- Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
- BREATHING APPARATUS**
- Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000
- BRIGHTNESS TEMPERATURE**
- TIMS calibration correction by comparison with PRT5 p 223 N92-11412
- BRINES**
- Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453
- BRISTOL-SIDDELEY BS 53 ENGINE**
- VSTOL engine design evolution: Growth of the Pegasus engine for Harrier [PNR-90805] p 99 N92-27039
- BROADCASTING**
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- BROWNIAN MOVEMENTS**
- Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- BRUSHES**
- The stability of graphite brushes at high velocity [ETN-91-90176] p 160 N92-12184
- BUDGETING**
- The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 N92-14046
- BUFFETING**
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- Review of aircraft dynamic loads due to flow separation p 31 N92-13008
- BUOYANCY**
- Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
- BUOYS**
- Accurate current measurement using drogued buoys employing Decca Navigator and Argos p 241 A92-12278
- Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88 p 242 A92-34878
- BURNING RATE**
- Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
- Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
- BYPASS RATIO**
- Rafale M - Dassault's Squall at sea p 71 A92-37874
- The evolution of the bypass engine [PNR-90832] p 99 N92-21850

C

- C BAND**
- First results from the Netherlands SAR testbed 'PHARS' --- Phased array universal SAR p 221 A92-34903
- Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
- C-130 AIRCRAFT**
- In situ measurements of the ice water content in cirrus clouds p 236 A92-22952
- CABLES (ROPES)**
- Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547
- CADMIUM TELLURIDES**
- Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
- CALCIUM SULFIDES**
- The near millimetre wavelength optical constants of calcium lanthanum sulphide --- for IR window applications in high-speed aircraft p 272 A92-52965
- CALCULUS OF VARIATIONS**
- Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312

- CALENDARS**
- Calendar of selected aeronautical and space meetings, July 1990 onwards [AGARD-CAL-90/2] p 275 N92-17198
- Calendar of selected aeronautical and space meetings, January 1992 and onwards [AGARD-CAL-92/1] p 275 N92-17212
- CALIBRATING**
- Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
- TIMS calibration correction by comparison with PRT5 p 223 N92-11412
- Study of interactions on anemoclinometric sensors [REPT-90/30] p 113 N92-12006
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 N92-17853
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 N92-29707
- CAMBER**
- Yacht sail aerodynamics. Part 3: Achievable jib sail specification [ISBN-0-904947-17-3] p 52 N92-70513
- Yacht sail aerodynamics. Part 2: Achievable mainsail specification [ISBN-0-904947-16-5] p 52 N92-70514
- CAMBERED WINGS**
- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- CAMERAS**
- A large format film camera for high precision object recording p 207 A92-51630
- Model incidence measurement using SAAB ELOPTOPOS system [NLR-TP-89182-U] p 115 N92-18416
- CANADIAN AIRCRAFT**
- Regional challenge --- flight test of Canadair Regional Jet p 74 A92-53121
- CANARD CONFIGURATIONS**
- The evaluation of canard couplings at high angles of attack [AIAA PAPER 92-0281] p 12 A92-25735
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003
- Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023
- SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249
- CANOPIES (VEGETATION)**
- Sodar wind speed profiles over forested boundary layer during the Hapex-Mobilhy campaign p 235 A92-17729
- The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
- Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506
- CAPILLARY FLOW**
- High performance capillary electrophoresis in microgravity environment p 206 A92-20996
- Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897
- CARBON DIOXIDE**
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 N92-21740
- CARBON DIOXIDE LASERS**
- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- CO2 laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535
- Reduction of target scattering by tropospheric modification p 157 N92-19164
- Set-up and alignment aspects of a CO2-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378
- The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300
- Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 N92-34152
- CARBON FIBER REINFORCED PLASTICS**
- Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088
- An integrated approach to developing tough epoxies p 145 A92-51563

- Hot melt joints for carbon fibre reinforced composites p 213 A92-54870
- Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP p 219 N92-14420
- Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- CFRP stiffened panels under compression p 146 N92-33044

CARBON FIBERS

- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-1-522/90] p 145 N92-10068
- Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 N92-18333
- Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043

CARBON-CARBON COMPOSITES

- Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
- Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 N92-12065
- Large thin composite thermostructural parts p 134 N92-23821

CARDIOVASCULAR SYSTEM

- Cardiological aspects of pilot's fitness to fly p 245 A92-16406
- Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- Control of blood pressure in humans under microgravity p 248 N92-23071

CARRIER WAVES

- Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134

CASCADE FLOW

- Blade defect force investigation in a compressor cascade p 6 A92-13233
- Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533
- Turbulence modelling for secondary flow prediction in a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535
- Three dimensional flow in a linear compressor cascade at design conditions [ASME PAPER 91-GT-114] p 8 A92-15565
- Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
- Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
- Transonic cascade flow prediction using the Navier-Stokes equations [ASME PAPER 91-GT-313] p 8 A92-15690
- Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines [ONERA, TP NO. 1991-170] p 110 A92-16135
- Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
- Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
- Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
- Secondary flow investigation inside the passage of a compressor cascade p 19 A92-42124
- The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
- Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver p 23 A92-48207
- Numerical computations of transonic flows through cascades [AIAA PAPER 92-3041] p 24 A92-48702
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462

- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

- Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades [ETN-92-92056] p 205 N92-33910

CASE HISTORIES

- Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827

CASSINI MISSION

- Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412
- The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
- CAPS-plasma spectrometer for the Cassini spacecraft p 140 N92-10565

CATALOGS (PUBLICATIONS)

- Catalogue of ESA patents [ESA-SP-1131-REV-1] p 287 N92-19411

CATAPULTS

- JPATS escape system development p 70 A92-35434
- Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970

CATHODE RAY TUBES

- Integrated helmet system testing for a nightflying helicopter p 90 A92-56291

CAUCHY PROBLEM

- Recent progress in reactive flow computations p 167 A92-26220
- From vortex layers to vortex sheets p 181 A92-50108

- Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 N92-19916

- A linearised Riemann solver for Godunov-type methods [CRANFIELD-AERO-9116] p 265 N92-19924

- Multidimensional upwind methods for unstructured grids p 201 N92-27675

- Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453

CAVITATION FLOW

- A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
- Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235

CAVITY FLOW

- An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
- An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124

CEILINGS (METEOROLOGY)

- Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037

CENTER OF MASS

- Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia --- aircraft models applied to real aircraft p 217 A92-12346

CENTRAL PROCESSING UNITS

- A SAR processor for a GIS environment p 155 A92-34980

CERAMIC COATINGS

- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292

CERTIFICATION

- Concorde flight testing - Powerplant and performance flying [SAE PAPER 912192] p 72 A92-40009
- AS 332 MKII - Development and certification p 75 A92-56343
- Fatigue life behaviour of composite structures p 145 N92-18577
- Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683
- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 N92-21847
- Impact of regulation changes on engine design and certification [PNR-90789] p 99 N92-22098

- Validation of simulation systems for aircraft acceptance testing p 86 N92-28531

- The use of load enhancement factors in the certification of composite aircraft structures [NLR-TP-90068-U] p 86 N92-28649

CHANNEL FLOW

- An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- Transition to turbulence in curved channel flow p 18 A92-40125
- Total losses in turbulent flows inside conical diffusers p 23 A92-47782
- Laminar channel flow over a square step p 180 A92-48254
- Superfluid vortex nucleation in He-3 flow p 271 N92-10479
- A subgrid-scale model based on the second-order velocity structure function p 203 N92-30651
- Continuous wavelet analysis of coherent structures p 203 N92-30673

CHAOS

- Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
- Unsteady three-dimensional Benard convection - Light-scattering, statistics and chaos p 168 A92-27379
- Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451
- Turbulence - The filtering approach p 175 A92-41656

CHAPLYGIN EQUATION

- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384

CHAPMAN-ENSKOG THEORY

- Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739

CHARGE COUPLED DEVICES

- A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
- Development of an electronic high speed camera system for the quantitative analysis of unsteady flows [MPIS-100/1991] p 209 N92-17344
- Model incidence measurement using SAAB ELOPTOPOS system [NLR-TP-89182-U] p 115 N92-18416
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 N92-29707

CHARTS

- The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 N92-10997

CHEBYSHEV APPROXIMATION

- Adaptive spectral methods with application to mixing layer computations p 182 A92-52404

CHECKOUT

- Expert system for the Tornado ground-based check-out system p 91 N92-12536

CHEMICAL COMPOSITION

- Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541
- Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

CHEMICAL EQUILIBRIUM

- Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
- Fast finite element solvers for reentry flows p 35 N92-14988
- High enthalpy nozzle flows p 36 N92-15000

CHEMICAL REACTIONS

- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 N92-14325
- Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 N92-14326

CHEMICAL WARFARE

- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

CHEST

- Rib cage shape and motion in microgravity p 247 A92-56944

CHIPS (ELECTRONICS)

- Code generation for fast DSP-based real-time control p 257 N92-12462

CIRCUIT PROTECTION

Protection concepts used in spacecraft power systems p 142 N92-13176

CIRCUIT RELIABILITY

Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630

CIRCULAR CONES

Asymmetric vortex flow over circular cones p 32 N92-13014

CIRCULAR CYLINDERS

Cylinder-induced shock-wave boundary-layer interaction p 15 A92-31188

Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347

Spin-up in a semicircular cylinder p 184 A92-56123

A short or a long cylinder: What difference does it make to the Karman vortex street? p 40 N92-17314

Investigation on the control of a Karman vortex street [MPIS-98/1990] p 40 N92-17315

CIRCULAR PLATES

Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745

CIRCULATION

Three dimensional flow in sharp bends --- ducted flow p 200 N92-27481

Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

CIRRUS CLOUDS

In situ measurements of the ice water content in cirrus clouds p 236 A92-22952

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

CIVIL AVIATION

Human resource management in aviation --- Book p 250 A92-13837

A conceptualization of aviation psychology on the civil flight deck p 250 A92-13849

The Eurofar vehicle overview p 67 A92-14416

Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134

Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934

Infra-red offers new landing aid competition p 88 A92-18937

High costs force avionics links p 88 A92-22000

Quantitative estimation of secondary surveillance radar information p 59 A92-24943

Anglo-American avionics p 2 A92-25575

Eurocontrol - UK detention rights p 280 A92-33048

A European perspective on the co-operative air traffic management concept p 60 A92-33427

An aircraft manufacturer's perspective p 2 A92-33430

The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257

Mass-transporter p 69 A92-34650

Insurers lose from high-risk deals p 279 A92-35474

Selected pitfalls and booby-traps in aircraft finance p 280 A92-35587

Tax aspects of aircraft leasing in the Netherlands p 280 A92-35588

Security rights in aircraft under Belgian law p 280 A92-35589

Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591

Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592

Aircraft financing in Spain p 280 A92-35593

Dutch security rights in aircraft and engines p 280 A92-35594

The role of the notary under the laws of the Netherlands - With respect to the transfer of title and encumbrance of registered aircraft p 280 A92-35595

The bullish bear --- airline operations decentralization in the Commonwealth of Independent States p 2 A92-36350

Ageing airliner census - Still flying safely p 54 A92-38374

Flying on thin ice p 54 A92-38375

Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382

GPS/GLONASS user systems in Sweden p 61 A92-38384

Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990 p 54 A92-39301

Civil aircraft design in relation to airworthiness p 54 A92-39303

Aircraft structural design p 72 A92-39304

Airport technology international 1992 p 111 A92-39514

Industrial practice in aeronautical maintenance p 3 A92-47774

Trends in commercial aircraft design - What evolution factors and what approach? p 4 A92-48587

Computer software in civil aircraft p 256 A92-49302

Progress towards quieter civil helicopters p 267 A92-52847

The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299

A systematic formulation, as an approach to air traffic [MBB-Z-0371-91-PUB] p 62 N92-10996

Military and civil software standards and guidelines for guidance and control p 257 N92-12452

Variability of standard aircraft performance parameters [ESDU-91020] p 77 N92-17847

The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574

Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683

Aircraft accident report: Unstabilized approach and loss of control NPA, Inc. dba United Express Flight 2415, British Aerospace BA-3101, N410UE, Tri-Cities Airport, Pasco, Washington, December 26, 1989 p 56 N92-21873

Flight simulation and digital flight controls p 115 N92-28526

Validation of simulation systems for aircraft acceptance testing p 86 N92-28531

European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605

Ageing aircraft research in the Netherlands p 57 N92-30129

The Eurofar program: An European overview on advanced VTOL civil transportation system [MBB-UD-0611-91-PUB] p 58 N92-30418

Radiation exposure of civil air carrier crewmembers [NLRGC/B-1-4/91] p 249 N92-33908

CLASSIFIERS

Sensor fault detection on board an aircraft with observer and polynomial classifier p 92 N92-29870

CLEARANCES

The use of optical sensors and signal processing gas turbine engines p 90 A92-46247

CLIMATE

Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-25329

CLIMATE CHANGE

Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354

CLIMATOLOGY

Polar lows affecting Denmark p 237 A92-32491

The main lines of the research programs remote sensing: Climate and environment [BCRS-91-25] p 230 N92-29499

CLIMBING FLIGHT

Variability of standard aircraft performance parameters [ESDU-91020] p 77 N92-17847

CLOSED ECOLOGICAL SYSTEMS

Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828

Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977

Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007

CLOSURE LAW

Computation of impinging flows using second-moment closures p 173 A92-40083

Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102

CLOUD COVER

A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487

Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037

CLOUD GLACIATION

A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994

Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds --- for aircraft icing p 53 A92-23302

CLOUD PHYSICS

A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994

Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds --- for aircraft icing p 53 A92-23302

Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354

Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645

Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541

CLOUDS

Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317

CLOUDS (METEOROLOGY)

A new thermometric instrument for airborne measurements in clouds p 88 A92-24918

Investigation of convection over sea by aircraft observations p 225 N92-26337

Remote sensing of atmosphere with aircraft borne lidar systems p 234 A92-26347

Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326

CLUSTER MISSION

The dynamics of the Cluster spacecraft p 137 N92-24510

Cluster: Fuel optimum spacecraft formation control p 122 N92-24777

Requirements for coordinated Cluster and ground-based observations of the cusp p 233 N92-26318

CLUTTER

Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293

CMOS

Architecture and interconnects of programmable processors of radar signals p 159 A92-23042

COASTAL WATER

Introduction: Ocean air observation p 224 N92-23381

COASTS

Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88 p 242 A92-34878

A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988 [AD-A246775] p 243 N92-28365

COAXIAL CABLES

Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134

COCKPIT SIMULATORS

Flying the A340 iron bird p 67 A92-10666

Utilization of a research simulator for the development of new flight control concepts [ONERA, TP NO. 1991-161] p 110 A92-16128

Concept for future cockpits p 88 A92-16148

Flight test of avionics and air-traffic control systems [ETN-92-91063] p 65 N92-25590

ATTAS experimental cockpit and ATMOS for flight control components and systems investigations p 65 N92-25595

COCKPITS

Decision support in the cockpit - Probably a good thing? p 251 A92-11135

Tomorrow's cockpit displays p 88 A92-13699

Concept for future cockpits p 88 A92-16148

The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849

Pilot attitudes to cockpit automation p 250 A92-44926

A340 handling, cockpit design improve on predecessor A320 p 73 A92-47969

Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895

Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547

COEFFICIENTS

Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 N92-14360

Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 N92-15040

A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741

COGNITION

- Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
- COGNITIVE PSYCHOLOGY**
- A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- Knowledge transfer and anticipation in airline piloting p 250 A92-45065

COLD FRONTS

- Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902

COLD WEATHER

- Polar lows affecting Denmark p 237 A92-32491

COLLISION AVOIDANCE

- The avoidance of collisions for Newtonian bodies with hidden variables p 59 A92-24945
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946
- The real TCAS --- traffic alert and collision avoidance system p 54 A92-25521
- UK airmisses involving commercial air transport: September - December 1990 p 56 A92-21746

COLLISIONLESS PLASMAS

- Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron plasma [DE92-614464] p 284 A92-22653

COLLOCATION

- Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 A92-24721
- Photographic observations of the co-located spacecraft at 19 deg West p 138 A92-24724

COLORIMETRY

- Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 A92-11288

COLUMBIA (ORBITER)

- Spectacular return for Columbia - Oldest Shuttle to make 13-day science mission p 128 A92-43596

COLUMBUS SPACE STATION

- Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
- Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings p 119 A92-32451
- Columbus user support organization concept in Italy p 119 A92-32465
- USO concept in the member states - Belgium p 119 A92-32466
- USO concept in the member states - The Netherlands p 120 A92-32467
- Swedish user support for Columbus p 120 A92-32469
- Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 A92-18649
- Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 A92-27023
- The USOCs, the resources management, and their links with telepresence p 276 A92-33466

COMBAT

- Optimal guidance anticipating missile performance p 128 A92-27902
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 A92-28541

COMBUSTIBLE FLOW

- Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
- Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
- Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102
- The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 A92-18934
- Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 A92-27484
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942

COMBUSTION CHAMBERS

- Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
- Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
- CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376
- Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599
- Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
- Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- Practical application of 3-D CFD methods to gas turbine combustors [PNR-90773] p 194 A92-21742
- Introduction of the solid fuel combustion chamber project p 142 A92-22269
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 A92-22270
- Spin-offs of the solid fuel combustion chamber project p 143 A92-22275
- Flow computation in combustion chambers using zonal nonstaggered grids p 200 A92-27483
- Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 A92-27484
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 A92-27490
- The impact of air transport on the environment [PNR-90876] p 230 A92-33751

COMBUSTION CHEMISTRY

- Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
- Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 A92-26086
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 A92-27490

COMBUSTION EFFICIENCY

- The coherent flamelet model for propulsion applications p 147 A92-27486

COMBUSTION PHYSICS

- Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
- Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467

- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942

COMBUSTION STABILITY

- Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467

COMBUSTION TEMPERATURE

- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017

COMETS

- Use of natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644

COMMERCIAL AIRCRAFT

- Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
- The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
- ARINC and commercial aircraft avionics. I p 60 A92-25655
- Eurocontrol - UK detention rights p 280 A92-33048
- The bullish bear --- airline operations decentralization in the Commonwealth of Independent States p 2 A92-36350
- The 1991 Cierva Lecture - Aberdeen and its influence on the evolution of the commercial IFR twin engine helicopter p 55 A92-43446
- Silent solutions --- noise suppression for Stage 3 corporate fleets p 96 A92-53120

- UK airmisses involving commercial air transport: September - December 1990 p 56 A92-21746
- [ETN-92-91050] p 44 A92-27708
- Drag reduction: An industrial challenge p 88 A92-33750

COMMERCIAL SPACECRAFT

- Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774

COMMUNICATION

- Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 A92-20715

COMMUNICATION EQUIPMENT

- Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 A92-12156

COMMUNICATION NETWORKS

- Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-SS-04-104-VOL-1-ISSUE] p 156 A92-14268
- Future developments in aeronautical satellite communications p 158 A92-24167

COMMUNICATION SATELLITES

- The enhancement of the Italsat spacecraft - A step forward the communication satellites [IAF PAPER 91-473] p 131 A92-18494
- Communication satellite system beyond the year 2000 [IAF PAPER 91-495] p 155 A92-18509
- Italsat spacecraft multibeam payload antenna closed loop fine pointing system [IAF PAPER 91-509] p 129 A92-18519
- Benefits of electric propulsion for orbit injection of communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709
- Apogee manoeuvre strategies for the Inmarsat-2 spacecraft [AAS PAPER 91-364] p 123 A92-43262
- LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468
- Lite-Sat's for specific communication tasks p 156 A92-15232
- Normalization, reliability and validation of information for spatial operations p 157 A92-15285
- Implementation of Inmarsat mobile satcom systems p 157 A92-24073
- Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 A92-24504

COMMUTER AIRCRAFT

- Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
- Dornier 328 - A Daimler for commuters p 69 A92-30091
- Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085

COMPARISON

- Comparison of LDA and LTA applications for propeller tests in wind tunnels [NLR-MP-88031-U] p 47 A92-28658
- Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 A92-30230

COMPILERS

- Process/object-oriented Ada software design for an experimental helicopter p 257 A92-12461

COMPOSITE MATERIALS

- Joining of composite materials to metals p 211 A92-10695
- Optimization of the flutter load by material orientation p 217 A92-15222
- Use of composite materials for aeronautical structure p 143 A92-15303
- The first fifty years of composite materials in aircraft construction p 69 A92-32325
- Why composites wait in the wings p 144 A92-35475
- Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings p 144 A92-42141
- Modeling and computation of composite materials [ONERA, TP NO. 1992-50] p 144 A92-48611
- Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-15745
- Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 A92-18333
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 A92-19938
- The search for new materials [PNR-90777] p 145 A92-21744
- Structural optimization of aircraft p 86 A92-28472

- Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474
- The use of load enhancement factors in the certification of composite aircraft structures [NLR-TP-90068-U] p 86 N92-28649
- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
- The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 N92-33033
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048
- COMPOSITE STRUCTURES**
- Dispersion curves analysis for bonded plates at low F_d p 217 A92-13540
- Mind that restyle --- failure analysis of aircraft composite structures p 53 A92-13700
- Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398
- The evolution from bonded F27 aircraft to A380 structures p 3 A92-41177
- Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- Fatigue life behaviour of composite structures p 145 N92-18577
- Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 N92-33033
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- CFRP stiffened panels under compression p 146 N92-33044
- Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048
- Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- Global/local interlaminar stress analysis of a grid-stiffened composite panel [NASA-CR-190822] p 221 N92-33139
- COMPRESSIBILITY**
- Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118
- COMPRESSIBILITY EFFECTS**
- A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098
- Compressibility effects in turbulent far wakes p 18 A92-40140
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
- Hypersonic boundary layers: Transition and turbulence effects p 188 N92-14976
- Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 N92-32769
- COMPRESSIBLE BOUNDARY LAYER**
- Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
- The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441
- Marco contract report [ETN-92-91077] p 193 N92-20232
- Instability and transition in compressible boundary layers [AD-A248596] p 201 N92-28062
- Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118
- COMPRESSIBLE FLOW**
- Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139
- A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
- Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
- An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
- Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
- Modelling compressible turbulent mixing p 178 A92-45094
- Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546
- A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
- Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- Application of a variational method in compressible flow computations p 179 A92-47070
- A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
- Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
- Adaptive spectral methods with application to mixing layer computations p 182 A92-52404
- A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
- Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
- Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures [DLR-FB-91-09] p 113 N92-12005
- Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003
- Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
- The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 N92-18934
- Cell vertex methods for compressible gas flows p 197 N92-26599
- Computational techniques for solving the Navier-Stokes equations p 198 N92-27451
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482
- Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
- Finite element methods for flow problems p 200 N92-27672
- Unstructured grid methods for compressible flows p 201 N92-27676
- Instability and transition in compressible boundary layers [AD-A248596] p 201 N92-28062
- COMPRESSION LOADS**
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043
- CFRP stiffened panels under compression p 146 N92-33044
- COMPRESSION TESTS**
- The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 N92-33033
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043
- CFRP stiffened panels under compression p 146 N92-33044
- COMPRESSIVE STRENGTH**
- The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 N92-33033
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043
- COMPRESSOR BLADES**
- Blade defect force investigation in a compressor cascade p 6 A92-13233
- Three dimensional flow in a linear compressor cascade at design conditions [ASME PAPER 91-GT-114] p 8 A92-15565
- Design and performance of advanced blading for a high-speed HP compressor [ASME PAPER 91-GT-374] p 9 A92-15718
- Validation of a 3D Navier-Stokes code on experimental compressor bladings [ONERA, TP NO. 1991-229] p 13 A92-26381
- Secondary flow investigation inside the passage of a compressor cascade p 19 A92-42124
- Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701
- Blade design and analysis using a modified Euler solver p 97 N92-13952
- Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 N92-27452
- COMPRESSOR EFFICIENCY**
- 3-D loss prediction based on secondary flow and blade shear layer interaction [ASME PAPER 91-GT-59] p 7 A92-15536
- Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
- COMPRESSOR ROTORS**
- Quasi-three-dimensional characteristics method for a supersonic compressor rotor [ASME PAPER 91-GT-81] p 7 A92-15549
- COMPRESSORS**
- Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction p 12 A92-24426
- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
- Calculation of installation effects within performance computer programs p 102 N92-28465
- COMPUTATION**
- Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950
- Computational procedures for preliminary design p 84 N92-23952
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 N92-28660
- COMPUTATIONAL FLUID DYNAMICS**
- High resolution schemes for steady flow computation p 161 A92-10036
- Vectorising the smooth particle hydrodynamics p 161 A92-10037
- Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 161 A92-10654
- Steady and unsteady 3D interactive boundary layers p 161 A92-10689
- Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
- Secondary separation from a slender wing p 6 A92-13448
- A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171
- Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483
- Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
- Transonic cascade flow prediction using the Navier-Stokes equations [ASME PAPER 91-GT-313] p 8 A92-15690
- Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822
- Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
- Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139
- Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors [ONERA, TP NO. 1991-178] p 10 A92-16140
- Asymptotic techniques for the analysis of fluid systems p 163 A92-16229
- Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455

- A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432
- A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
- Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
- Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
- An approximate method for treating a turbulent boundary layer with symmetry of revolution p 164 A92-21306
- Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461
- A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
- Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703
- Computational methods in viscous aerodynamics --- Book p 11 A92-21976
- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185
- IGG - An interactive 3D surface modelling and grid generation system [AIAA PAPER 92-0073] p 256 A92-22186
- Parallel algorithms for panel methods --- in fluid dynamics p 165 A92-22346
- Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446
- An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- Numerical computation of internal and external flows. Vol. 2 - Computational methods for inviscid and viscous flows --- Book [ISBN 0-471-92351-6] p 166 A92-22624
- A fire field model implemented in a parallel computing environment p 166 A92-23252
- Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289
- Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803
- A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
- Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- Recent progress in reactive flow computations p 167 A92-26220
- Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-26269
- Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
- Aerodynamic computations of high-speed transonic propellers [ONERA, TP NO. 1991-218] p 13 A92-26370
- CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376
- Validation of a 3D Navier-Stokes code on experimental compressor bladings [ONERA, TP NO. 1991-229] p 13 A92-26381
- Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes [ONERA, TP NO. 1991-237] p 13 A92-26387
- Unsteady three-dimensional Bénard convection - Light-scattering, statistics and chaos p 168 A92-27379
- Internal flow modelling of vortex throttles p 168 A92-27385
- Solving conservation laws with parabolic and cubic splines p 262 A92-27737
- A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
- Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
- Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
- Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599
- Numerical fluid mechanics - Incompressible flows with complex boundaries --- Book [ISBN 3-540-53137-8] p 169 A92-29649
- Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
- Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
- Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
- Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics [ONERA, TP NO. 1992-30] p 171 A92-31488
- A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
- Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
- A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
- The computation of three-dimensional flows using unstructured grids p 16 A92-37539
- Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
- An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
- Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573
- Well-posedness in the generalized sense for the incompressible Navier-Stokes equation p 262 A92-37789
- On inertial waves in the earth's fluid core p 231 A92-37905
- Playing with nonuniform grids p 172 A92-37936
- World Congress on Computational Mechanics, 2nd, Universität Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers p 262 A92-38401
- A theoretical test of the geostrophic momentum approximation p 237 A92-39471
- Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054
- Computation of impinging flows using second-moment closures p 173 A92-40083
- Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
- An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
- Computations of a separated turbulent boundary layer p 174 A92-40131
- The effects of viscosity and diffusion on a superersonic mixing layer p 18 A92-40143
- A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
- Progress and paradoxes in modelling near-wall turbulence p 174 A92-40158
- Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
- Extrapolation procedures for the time-dependent Navier-Stokes equations p 19 A92-41289
- On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
- The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814
- An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
- A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300
- Axisymmetric laminar interacting boundary layers p 176 A92-42534
- Differential forms and fluid dynamics p 176 A92-42535
- Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
- A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068
- Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
- Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
- Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
- Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477
- The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations [AIAA PAPER 92-2619] p 256 A92-45492
- A new automatic grid generation environment for CFD applications [AIAA PAPER 92-2720] p 21 A92-45558
- Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections [AIAA PAPER 92-2653] p 21 A92-45569
- Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
- Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
- Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261
- The nonlinear stability of flows over compliant walls p 179 A92-46265
- The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441
- Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
- Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
- Experimental and computational studies of hovering rotor flows p 22 A92-46954
- A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
- An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
- Patch-independent structured multiblock grids for CFD computations p 263 A92-47078
- Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157
- The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
- Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method p 105 A92-47779
- A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
- Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
- An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206
- Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver p 23 A92-48207
- Laminar channel flow over a square step p 180 A92-48254
- Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method [ONERA, TP NO. 1992-1] p 23 A92-48577
- Navier-Stokes computation over a three-dimensional ramp [ONERA, TP NO. 1992-55] p 181 A92-48616
- Modeling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
- Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701
- Numerical computations of transonic flows through cascades [AIAA PAPER 92-3041] p 24 A92-48702
- Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
- A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891

Some problems of the stability of a system of three vortices p 182 A92-51893

A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028

Adaptive spectral methods with application to mixing layer computations p 182 A92-52404

Rarefied gas dynamics; Proceedings of the 17th International Symposium, Rheinisch-Westfälische Technische Hochschule Aachen, Germany, July 8-14, 1990 p 274 A92-52701

[ISBN 1-56081-122-6] p 274 A92-52701

The Harold Grad Lecture - Mathematics and the Boltzmann equation p 274 A92-52702

Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724

Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734

Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739

Rarefied gas flow around a disc with different angles of attack p 25 A92-52753

Force and heat transfer on a disc in rarefied flow p 25 A92-52764

Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770

Efficient computation of particle movement in 3-D DSMC calculations on structured body-fitted grids p 256 A92-52771

Transport coefficients in discrete kinetic theory and comparison with classical fluid dynamics p 274 A92-52782

Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785

Entropy production in gaseous boundary layers p 183 A92-52814

Insight into singular vortex flows p 183 A92-53052

Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080

Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface p 263 A92-54574

Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963

Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971

Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477

Spin-up in a semicircular cylinder p 184 A92-56123

An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124

Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125

The computation and validation of hovering rotor performance p 74 A92-56285

Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332

A comparison of numerical predictions and experiments on under-expanded jets p 141 A92-56849

[AIAA PAPER 92-4027] p 141 A92-56849

The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449

Modeling and numerical simulation of vortex flow in aerodynamics p 30 A92-12997

[AD-B163670L] p 30 A92-12997

Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 187 A92-14319

[RAE-TM-P-1205] p 187 A92-14319

Aerothermodynamics for Space Vehicles p 33 A92-14973

[ESA-SP-318] p 33 A92-14973

Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980

A multiblock flow solver for inviscid hypersonic flows p 34 A92-14986

Fast finite element solvers for reentry flows p 35 A92-14988

Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 A92-14990

Linear acoustics in gas mixtures with rate processes p 269 A92-15013

Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 A92-15018

Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 A92-15023

Computer Graphics and Flow Visualization in Computational Fluid Dynamics p 189 A92-16226

Three-dimensional computer graphics in flow visualization p 189 A92-16227

The recovering of flow features from large numerical data bases p 189 A92-16231

Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 A92-17312

Physical and computational modelling of stratified shear flows p 190 A92-17974

[AERO-REPT-8909] p 190 A92-17974

The Goldstein Engineering Research Laboratory [AERO-REPT-8906] p 5 N92-18322

Modelling of interfacial and thermocline waves p 243 A92-18340

[AERO-REPT-9004] p 243 A92-18340

The installation of the AVRO 9 by 7 foot low-speed wind tunnel at the University of Manchester (England) [AERO-REPT-9005] p 114 A92-18341

Drag prediction using computation methods [ONERA-RSF-82/1685-AY-154-4] p 41 A92-19682

Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 A92-20179

Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds p 41 N92-20498

[NLR-TP-90029-U] p 41 N92-20498

Air intakes for high speed vehicles [AGARD-AR-270] p 41 N92-20797

Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703

Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 A92-21704

Practical application of 3-D CFD methods to gas turbine combustors [PNR-90773] p 194 A92-21742

Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 N92-22179

Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 N92-22180

Case 7.4 delta wing: Navier-Stokes calculation p 42 N92-22182

Introduction of the solid fuel combustion chamber project p 142 N92-22269

Numerical prediction of boundary layers and transitional flows p 196 N92-24342

Hypersonic configurations in slow speed flight p 43 N92-24394

Turbulence modelling in CFD: Present status, future prospects p 197 N92-24515

Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897

The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 N92-27062

CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450

Computational techniques for solving the Navier-Stokes equations p 198 N92-27451

Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469

Three dimensional flow in sharp bends --- ducted flow p 200 N92-27481

The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482

Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483

Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

Nonequilibrium 3D flows of air through inlets p 200 N92-27487

Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490

Finite element methods for flow problems p 200 N92-27672

Multidimensional upwind methods for unstructured grids p 201 N92-27675

Unstructured grid methods for compressible flows p 201 N92-27676

A frontal approach for node generation in Delaunay triangulations p 201 N92-27680

Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936

Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949

Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657

Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods [NLR-TP-89119-U] p 47 N92-28659

Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects [NLR-TP-90184-U] p 201 N92-28694

Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712

Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 N92-29604

Dynamic solder management [AD-A250564] p 150 N92-29647

Aeronautical Engineering Group publications, 1950 - present [AERO-REPT-8907] p 202 N92-29683

A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741

Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements [ETN-92-91492] p 49 N92-29889

Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926

The 2D-computation of an axial fan with FINFLO [PB92-180678] p 203 N92-30023

A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 N92-30454

Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB-FE211/S/PUB/466] p 204 N92-30674

Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB-FE211/S/PUB/474] p 5 N92-30675

CFD contributions during hypersonic airplane intake design [MBB-FE213/S/PUB/459] p 50 N92-30676

MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document [FFA-TN-1990-20] p 50 N92-30713

Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673

Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 N92-32725

NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750

Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 N92-32769

Pressure field developed by the random movement of the vortices near a wall [ETN-92-91665] p 204 N92-32770

Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800

CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 N92-32835

Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694

Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades [ETN-92-92056] p 205 N92-33910

The 3-D Euler flows around modern airplanes [PB92-138759] p 52 N92-70540

LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983

COMPUTATIONAL GRIDS

The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology [ASME PAPER 91-GT-124] p 8 A92-15569

Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625

Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126

Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703

- IGG - An interactive 3D surface modelling and grid generation system
[AIAA PAPER 92-0073] p 256 A92-22186
Embedded meshes of controllable quality synthesised from elementary geometric features
[AIAA PAPER 92-0663] p 261 A92-27034
Cell vertex finite volume discretizations in three dimensions p 168 A92-27475
Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics
[ONERA, TP NO. 1992-30] p 171 A92-31488
Structural optimization at Aerospatiale Aircraft
[AIAA PAPER 92-2371] p 256 A92-34542
A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
The computation of three-dimensional flows using unstructured grids p 16 A92-37539
Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573
Playing with nonuniform grids p 172 A92-37936
Panel method control in 3-D hyperbolic grid generation p 17 A92-39940
An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
A new automatic grid generation environment for CFD applications
[AIAA PAPER 92-2720] p 21 A92-45558
Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
Mesh adaptation for 2D transonic Euler flows on unstructured meshes p 22 A92-47038
Mesh adaptivity with the quadtree method p 22 A92-47041
An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
An unstructured mesh generation algorithm for three-dimensional aeronautical configurations p 262 A92-47053
Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
Application of a variational method in compressible flow computations p 179 A92-47070
Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
Efficient computation of body movement in 3-D DSMC calculations on structured particle-fitted grids p 256 A92-52771
The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh
[ONERA-RT-56/3064-RY-006-R] p 28 A92-10989
Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing
[AD-B163639L] p 30 A92-12998
Vortical flow simulation by using structured and unstructured grids p 30 A92-12999
Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 A92-14978
Interactive visualization of CFD results ASCETE p 190 A92-16235
Numerical grid generation using a variational method
[MBB-FE211-S-PUB-447] p 190 A92-17312
Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds
[NLR-TP-90029-U] p 41 A92-20498
Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 A92-22181
Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 A92-24411
TRANSF3: A 3-D grid generator based on transfinite interpolation
[PB92-151919] p 259 A92-25519
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-190353] p 43 A92-25959
Cell vertex methods for compressible gas flows p 197 A92-26599
An integrated CFD system for 3D turbomachinery applications p 101 A92-27464
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 A92-27466
Flow computation in combustion chambers using zonal nonstaggered grids p 200 A92-27483
Special Course on Unstructured Grid Methods for Advection Dominated Flows
[AGARD-R-787] p 200 A92-27671
Finite element methods for flow problems p 200 A92-27672
Multidimensional upwind methods for unstructured grids p 201 A92-27675
Unstructured grid methods for compressible flows p 201 A92-27676
A frontal approach for node generation in Delaunay triangulations p 201 A92-27680
Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 A92-27948
Wave drag determination in the transonic full-potential flow code MATRICS
[NLR-TP-90062-U] p 47 A92-28709
Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement
[NLR-TP-90134-U] p 202 A92-28712
Hyperbolic grid generation control by panel methods
[NLR-TP-91061-U] p 264 A92-29604
A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-73] p 203 A92-30454
A dynamic subgrid-scale eddy viscosity model p 203 A92-30649
CFD contributions during hypersonic airplane intake design
[MBB/FE213/S/PUB/459] p 50 A92-30676
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations
[NLR-TP-91046-U] p 51 A92-32730
Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations
[ONERA-RSF-24/1408-AY-150A] p 51 A92-32773
Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow
[PB92-138718] p 53 A92-70577
- COMPUTER AIDED DESIGN**
Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations
[ONERA, TP NO. 1991-187] p 10 A92-16141
Delivered with feeling --- computer-based design of flight control system for Boeing 777 p 103 A92-16621
From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot
[ONERA, TP NO. 1991-216] p 260 A92-26368
Structural optimization at Aerospatiale Aircraft
[AIAA PAPER 92-2371] p 256 A92-34542
Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
Two-point optimization of complete three-dimensional airplane configuration
[AIAA PAPER 92-2618] p 73 A92-45491
A new automatic grid generation environment for CFD applications
[AIAA PAPER 92-2720] p 21 A92-45558
Patch-independent structured multiblock grids for CFD computations p 263 A92-47070
ACLICO: An aid system for designing bonded joints
[REPT-911-430-134] p 152 A92-12146
Process/object-oriented Ada software design for an experimental helicopter p 257 A92-12461
Review of aerodynamic design in the Netherlands p 76 A92-13929
A PC-based inverse design method for radial and mixed flow turbomachinery p 97 A92-13943
RAMREC: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 A92-18647
Collection of product assurance data and their effective utilization p 216 A92-18651
Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 A92-19151
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems
[PNR-90839] p 98 A92-20573
Compressing the compressor p 99 A92-21848
First approach to an integrated fin design p 83 A92-23236
Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 A92-23238
Structural optimization of aircraft practice and trends p 83 A92-23239
Applications of ASICs to avionics
[AGARD-AG-329] p 92 A92-28376
Integrated Design Analysis and Optimisation of Aircraft Structures
[AGARD-LS-186] p 85 A92-28469
Fundamentals of structural optimisation p 86 A92-28470
The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 A92-28539
Constrained spanload optimization for minimum drag of multi-lifting-surface configurations
[NLR-TP-89126-U] p 47 A92-28660
MBB-LAGRANGE: A general structural reliability and optimization structural system
[MBB/FW321/S/PUB/467] p 220 A92-30423
Concurrent engineering p 260 A92-30952
SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods
[PB91-219444] p 52 A92-70249
Yacht sail aerodynamics. Part 1: Optimising overall performance
[TT-8903-PT-1] p 52 A92-70499
- COMPUTER AIDED MANUFACTURING**
Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings p 144 A92-42141
- COMPUTER AIDED MAPPING**
Iberia's Aeronautical Mapping Application (ACAI) p 60 A92-37073
- COMPUTER AIDED TOMOGRAPHY**
Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry
[REPT-90/55] p 187 A92-12216
- COMPUTER ANIMATION**
Numerical flow visualization of high Reynolds number recirculated flows using an animation technique
[ONERA, TP NO. 1991-215] p 168 A92-26367
Visualization of results of mathematical simulations: The contribution of MCG p 190 A92-16236
FLOVIS (Flow Visualizer) user manual, release 2.6, September 1990 p 190 A92-16238
- COMPUTER GRAPHICS**
CFView - An advanced interactive visualization system based on object-oriented approach
[AIAA PAPER 92-0072] p 255 A92-22185
IGG - An interactive 3D surface modelling and grid generation system
[AIAA PAPER 92-0073] p 256 A92-22186
Iberia's Aeronautical Mapping Application (ACAI) p 60 A92-37073
Multigrid grid generation in scalar and parallel environments p 256 A92-47084
Mixed approach towards modular avionics conflicting requirements p 91 A92-14051
Computer Graphics and Flow Visualization in Computational Fluid Dynamics
[VKI-LS-1991-07] p 189 A92-16226
Three-dimensional computer graphics in flow visualization p 189 A92-16227
The recovering of flow features from large numerical data bases p 189 A92-16231
Visualization of instationary flows by particle traces p 189 A92-16234
Interactive visualization of CFD results ASCETE p 190 A92-16235
Visualization of results of mathematical simulations: The contribution of MCG p 190 A92-16236
Mikado: A graphic program p 190 A92-16237
FLOVIS (Flow Visualizer) user manual, release 2.6, September 1990 p 190 A92-16238
- COMPUTER NETWORKS**
The CSMA/CD local area network for hospital services p 157 A92-15284
- COMPUTER PROGRAMMING**
Requirements --- software development methods taking into account time and cost constraints p 255 A92-19382
World Congress on Computational Mechanics, 2nd, Universitat Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers p 262 A92-38401
Software methodologies for safety critical systems p 257 A92-14267
- COMPUTER PROGRAMS**
Vectorising the smooth particle hydrodynamics p 161 A92-10037
Iberia's Aeronautical Mapping Application (ACAI) p 60 A92-37073
Computer codes for ballistic performance calculations of base bleed propellant grain p 17 A92-39433

- Large-eddy simulation of the convective boundary layer
- A comparison of four computer codes p 173 A92-40054
- A progress report on ASTOVL control concept studies under the VAAC programme p 104 A92-45319
- The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations p 256 A92-45492 [AIAA PAPER 92-2619]
- Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code p 185 N92-11306 [CERT-RT-63/5618-54]
- Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile p 185 N92-11307 [CERT-RT-65/5604-35]
- Military and civil software standards and guidelines for guidance and control p 257 N92-12452
- A practical experience of Ada for developing embedded software p 257 N92-12465
- Software methodologies for safety critical systems p 257 N92-12467
- A PC-based inverse design method for radial and mixed flow turbomachinery p 97 N92-13943
- Determination of rotor dynamic coefficients for labyrinth seals and application to rotor dynamic design calculations p 213 N92-14360
- Application of MSC/DYNA to shock and impact problems in aircraft industry p 219 N92-14382 [MBB-UD-0593-91-PUB]
- A concept for the revisions of structural inspection schedules p 215 N92-14431
- Software product assurance requirements for ESA space systems p 257 N92-14631 [ESA-PSS-01-21-ISSUE-2]
- Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008
- Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023
- A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026
- Project of an adaptive multiaxial autopilot with learning pilot control p 107 N92-15072 [ETN-92-90592]
- Computer Graphics and Flow Visualization in Computational Fluid Dynamics p 189 N92-16226 [VKI-LS-1991-07]
- Interactive visualization of CFD results ASCETE p 190 N92-16235
- Visualization of results of mathematical simulations: The contribution of MCG p 190 N92-16236
- Steps toward acceptance p 63 N92-19046
- Validation of flight critical control systems p 108 N92-20026 [AGARD-AR-274]
- MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document p 41 N92-20468 [FFA-TN-1990-19]
- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600 [PB92-151919]
- Why is space software special? p 258 N92-20626
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- TRANSF3: A 3-D grid generator based on transfinite interpolation p 259 N92-25519 [PB92-151919]
- Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- Calculation of installation effects within performance computer programs p 102 N92-28465
- Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547
- Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods p 47 N92-28659 [NLR-TP-89119-U]
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations p 47 N92-28660 [NLR-TP-89126-U]
- CFD efforts in the Netherlands p 205 N92-32835 [NLR-TP-91250-U]
- PROCRU simulation results compared with Metro 2 in-flight ILS approach data p 67 N92-70564 [PB92-138502]
- COMPUTER SYSTEMS DESIGN**
- The electronic aeronautical chart for general aeronautics: A system specification p 62 N92-10997 [ILR-MITT-263(1991)]
- Formal specification of satellite telemetry: A practical experience p 129 N92-12456
- Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
- Extension of the Frankfurt COMPAS for general application p 63 N92-19048
- Delfi: Design, development, and applicability of expert systems shells [ISBN-90-6275-734-0] p 259 N92-25306
- COMPUTER SYSTEMS PERFORMANCE**
- Parallel processing applications for gas turbine engine control p 96 N92-11012
- Formal verification of a redundancy management algorithm p 257 N92-12457
- Evaluation of the COMPAS operational system p 63 N92-19047
- COMPUTER SYSTEMS SIMULATION**
- Simulation and control of large software projects p 258 N92-20615
- COMPUTER TECHNIQUES**
- A computerized flight inspection system --- for testing of basic air navigation ground facilities p 61 A92-43881
- Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique p 26 A92-54308
- Development of tactical decision aids p 90 N92-12532
- COMPUTER VISION**
- Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories p 129 A92-12473 [IAF PAPER 91-059]
- COMPUTERIZED SIMULATION**
- Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625
- The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- A fire field model implemented in a parallel computing environment p 166 A92-23252
- Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow p 255 A92-26355 [ONERA, TP NO. 1991-196]
- Validation of a 3D Navier-Stokes code on experimental compressor blades p 13 A92-26381 [ONERA, TP NO. 1991-229]
- Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes p 13 A92-26387 [ONERA, TP NO. 1991-237]
- Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800
- Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
- Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392
- Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics p 171 A92-31488 [ONERA, TP NO. 1992-30]
- Modelling of aerospace materials - Not just a pretty picture p 212 A92-33363
- Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- DANSIM - Danish Airport Noise Simulation Model - Basic principles, experience, and improvements p 227 A92-39055
- DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
- Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172
- Computer simulation of an unsteady flow around an airfoil with a spoiler p 19 A92-43167
- Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261
- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079
- A numerical simulation of injection of droplets in a compressible flow p 180 A92-47899 [AIAA PAPER 92-2929]
- The numerical simulation of the main fuel control unit of gas turbine engines p 96 A92-49115 [AIAA PAPER 92-3760]
- Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511
- Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155
- Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302
- Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
- Superfluid vortex nucleation in He-3 flow p 271 N92-10479
- Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997
- Mixed approach towards modular avionics conflicting requirements p 91 N92-14051
- A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 N92-15018
- The recovering of flow features from large numerical data bases p 189 N92-16231
- Visualization of instationary flows by particle traces p 189 N92-16234
- Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
- Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 N92-20477
- Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 84 N92-23951
- Modeling and simulation of complex mechanical systems for space applications p 135 N92-24389
- Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 N92-24411
- Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 N92-25959
- Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 N92-27452
- Three dimensional flow in sharp bends --- ducted flow p 200 N92-27481
- The coherent flamelet model for propulsion applications p 147 N92-27486
- Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
- Fuzzy guidance system evaluation p 259 N92-27903
- Aircraft ship operations [AGARD-AR-312] p 85 N92-28468
- Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529
- Dynamic solder management [AD-A250564] p 150 N92-29647
- Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
- NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767
- Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 N92-32769
- Finite element simulation of viscoelastic flow p 205 N92-34038
- The 3-D Euler flows around modern airplanes [PB92-138759] p 52 N92-70540
- PROCRU simulation results compared with Metro 2 in-flight ILS approach data p 67 N92-70564 [PB92-138502]
- Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow [PB92-138718] p 53 N92-70577
- COMPUTERS**
- Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547
- CONCAVITY**
- Boundary layer transition on concave surfaces p 195 N92-22200
- Boundary layers and transition on concave surfaces p 196 N92-24341
- CONCENTRATORS**
- Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- CONCENTRICITY**
- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124

CONCORDE AIRCRAFT

- Mind that restyle --- failure analysis of aircraft composite structures p 53 A92-13700
 Concorde flight testing - Powerplant and performance flying [SAE PAPER 912192] p 72 A92-40009
 Surface activation of Concorde by Be-7 p 271 N92-23295

CONDENSATION NUCLEI

- Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354

CONDUCTIVE HEAT TRANSFER

- On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory p 184 A92-55479
 Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978

CONES

- Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 N92-14992
 Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231

CONFERENCES

- Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 161 A92-10654
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 Vortex Flow Aerodynamics [AGARD-CP-494] p 30 N92-12996
 Review of aircraft dynamic loads due to flow separation p 31 N92-13008
 Calendar of selected aeronautical and space meetings, July 1990 onwards [AGARD-CAL-90/2] p 275 N92-17198
 Calendar of selected aeronautical and space meetings, January 1992 and onwards [AGARD-CAL-92/1] p 275 N92-17212
 Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
 The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933
 The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 N92-18934
 High Altitude and High Acceleration Protection for Military Aircraft [AGARD-CP-516] p 247 N92-18972

- Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008
 Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679
 Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951
 Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227
 Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
 Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
 Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
 Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668
 CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450
 Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870
 Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
 Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
 Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
 Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 N92-32229
 Symposium on dynamic balancing p 221 N92-71104

CONFIGURATION MANAGEMENT

- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600

CONFORMAL MAPPING

- Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511

CONGRESSIONAL REPORTS

- Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076

CONICAL FLOW

- Asymmetric vortex flow over circular cones p 32 N92-13014

CONJUGATE GRADIENT METHOD

- Parallel algorithms for panel methods --- in fluid dynamics p 165 A92-22346
 Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312

CONSERVATION EQUATIONS

- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 N92-27678

CONSERVATION LAWS

- Solving conservation laws with parabolic and cubic splines p 262 A92-27737
 Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
 The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model --- of trace elements in middle atmosphere p 239 A92-53349
 Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 N92-23251
 Multidimensional upwind methods for unstructured grids p 201 N92-27675

CONSTITUTIVE EQUATIONS

- Modeling and computation of composite materials [ONERA, TP NO. 1992-50] p 144 A92-48611
 Finite element simulation of viscoelastic flow p 205 N92-34038

CONSTRAINTS

- Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233

CONSULTING

- International collaboration in PA and safety, the Eurospace PA-Panel p 215 N92-18608

CONTACT RESISTANCE

- Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118

CONTAINERS

- Marangoni convection in V-shaped containers p 172 N92-37932

CONTAMINANTS

- Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

CONTAMINATION

- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
 Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284

CONTINUITY EQUATION

- Solving conservation laws with parabolic and cubic splines p 262 A92-27737

CONTINUOUS WAVE LASERS

- Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378

CONTINUUM FLOW

- Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
 Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032

CONTINUUM MODELING

- Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791

CONTRACTS

- Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659

CONTRAILS

- Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

CONTROL SIMULATION

- Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
 A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
 Double loop control law strategy and applications to helicopter [CERT-2/7724-DERA] p 108 N92-19295
 Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
 Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs p 136 N92-24493
 On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
 Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 N92-24504

CONTROL STABILITY

- VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561

CONTROL SURFACES

- Aircraft ground vibration test by means of flight control surfaces [ONERA, TP NO. 1991-96] p 103 A92-16079
 Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
 Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 N92-18790
 Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795
 Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970

CONTROL SYSTEMS DESIGN

- VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561
 An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
 Utilization of a research simulator for the development of new flight control concepts [ONERA, TP NO. 1991-161] p 110 A92-16128
 Delivered with feeling --- computer-based design of flight control system for Boeing 777 p 103 A92-16621
 Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094
 The use of inverse simulation for conceptual design p 70 A92-35738
 A survey of active control in aircraft cabins p 72 A92-39084
 Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908
 Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322
 Fibre optic rotary position sensors for vehicle and propulsion controls p 90 A92-46243
 Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
 The numerical simulation of the main fuel control unit of gas turbine engines [AIAA PAPER 92-3760] p 96 A92-49115

- Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- Robust flight control systems - A parameter space design p 106 A92-50503
- Machine Intelligence for Aerospace Electronic Systems p 261 N92-12517
- [AGARD-CP-499] p 261 N92-12517
- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
- Double loop control law strategy and applications to helicopter p 108 N92-19295
- [CERT-2/7724-DERA] p 108 N92-19295
- Robust control system design with application to high performance helicopters p 108 N92-19621
- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600
- The integration and test of modern spacecraft control systems p 261 N92-20601
- Approach and landing guidance p 65 N92-21960
- Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 N92-24351
- Design aspects of the attitude control system for the SOHO spacecraft p 135 N92-24433
- The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- Low cost spacecraft attitude sensors p 140 N92-24458
- Control strategies for space systems p 137 N92-24494
- Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- Control concepts for active magnetic bearings p 214 N92-27743
- Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
- Use of a research simulator for the development of new concepts of flight control p 116 N92-28543
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616
- CONTROL THEORY**
- Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
- Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815
- Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 N92-12004
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581
- CONTROLLABILITY**
- Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616
- A background to the handling qualities of aircraft [ESDU-92006] p 109 N92-32780
- CONTROLLED ATMOSPHERES**
- Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892
- CONTROLLERS**
- VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561
- Robust flight control systems - A parameter space design p 106 A92-50503
- Parallel processing applications for gas turbine engine control p 96 N92-11012
- Code generation for fast DSP-based real-time control p 257 N92-12462
- Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
- Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- Control strategies for space systems p 137 N92-24494
- Fuzzy guidance system evaluation p 259 N92-27903
- CONVECTION**
- Melting and dissolving p 178 A92-46260
- Measurements of the dynamic stall vortex convection speed p 27 A92-56351
- Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897
- Investigation of convection over sea by aircraft observations p 225 N92-26337
- CONVECTION CLOUDS**
- A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994
- CONVECTION-DIFFUSION EQUATION**
- Playing with nonuniform grids p 172 A92-37936
- Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
- Finite element methods for flow problems p 200 N92-27672
- CONVECTIVE FLOW**
- On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-26269
- Polar lows affecting Denmark p 237 A92-32491
- Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054
- The laminar natural convection on a horizontal surface [AERO-REPT-9015] p 191 N92-18236
- Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
- Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166
- CONVECTIVE HEAT TRANSFER**
- Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450
- Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
- Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
- CONVERGENCE**
- Parallel and vector aspects of a multigrid Navier-Stokes solver [PB91-232868] p 260 N92-16645
- COOLANTS**
- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- COOLING**
- Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
- COOLING SYSTEMS**
- Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667
- An overview of ESA cryocooler activities p 154 N92-25850
- Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851
- The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853
- Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875
- Integrated heat pipe concept for Li/SOC12 cells cooling p 160 N92-26974
- The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986
- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- COORDINATION**
- COMPAS system concept p 63 N92-19043
- COPOLYMERIZATION**
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479
- COPPER ALLOYS**
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
- CORE FLOW**
- On inertial waves in the earth's fluid core p 231 A92-37905
- CORES**
- Magnetic suspension using high temperature superconducting cores p 161 N92-27789
- Exotic states in the cores of quantized vortices for superfluids and superconductors [DE92-728466] p 206 N92-70151
- CORNER FLOW**
- Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
- Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784
- CORONARY ARTERY DISEASE**
- Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405
- Cardiological aspects of pilot's fitness to fly p 245 A92-16406
- CORRELATION**
- Velocity correlation in isotropic turbulence according to a modified Obukhov theory p 169 A92-28950
- CORRELATION COEFFICIENTS**
- Statistical methods applicable to analysis of aircraft performance data [ESDU-91017] p 77 N92-18096
- CORROSION**
- Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- CORROSION RESISTANCE**
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
- CORROSION TESTS**
- Aerospace Arali - A challenge for the aircraft designer p 143 A92-10232
- New accelerated corrosion test methods [MBB-Z-0406-91-PUB] p 150 N92-32895
- COSMIC RAYS**
- Surface activation of Concorde by Be-7 p 271 N92-23295
- LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231
- COSMOS SATELLITES**
- Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808
- COSPAS**
- Error analysis of the COSPAS SARSAT system p 129 A92-21288
- COST EFFECTIVENESS**
- Cost effective solutions for titanium sheet metal forming p 211 A92-22785
- Avionics standardization in Europe p 91 N92-14050
- Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950
- COST REDUCTION**
- Potential hypersonic vehicles applications [AIAA PAPER 91-5088] p 1 A92-17854
- Organizational impediments to the reduction of costs of space programmes [IAF PAPER 91-639] p 278 A92-20591
- Reducing risks p 278 A92-22725
- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- Low cost spacecraft attitude sensors p 140 N92-24458
- COUPLED MODES**
- An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
- COUPLING**
- Dynamic load cases on Ariane 5 p 127 N92-23797
- On the analysis of liquid filled free-free tanks p 196 N92-23843
- CRACK INITIATION**
- Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
- CRACK PROPAGATION**
- Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
- Effects of spectrum variations on fatigue crack growth p 219 A92-57399
- Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045
- Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 N92-14397
- The G-222 aircraft individual tracking programme p 78 N92-18582
- Fatigue management for the A-7P p 79 N92-18593
- The role of crack growth in defect assessment [PNR-90798] p 220 N92-20909
- Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966

- Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys
[NLR-TP-90172-U] p 220 N92-28850
- CRACKING (FRACTURING)**
Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
- CRANIUM**
G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
- CREEP STRENGTH**
High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
- CREEP TESTS**
High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
- CRITICAL FLOW**
Air intakes for high speed vehicles
[AGARD-AR-270] p 41 N92-20797
- CRITICAL FREQUENCIES**
Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956
- CROP GROWTH**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- CROSS CORRELATION**
Atmospheric turbulence spectra and correlation functions
[NLR-TP-89217-U] p 234 N92-28689
- CROSS FLOW**
Vortex instabilities in three-dimensional boundary layers
- The relationship between Goertler and crossflow vortices p 163 A92-16043
Model and computation of discrete jets in crossflow p 165 A92-21505
Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446
Impinging jets in cross-flow p 169 A92-28942
Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549
The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
Instability and transition in compressible boundary layers
[AD-A248596] p 201 N92-28062
- CRUISE MISSILES**
The ASMP program p 3 A92-41823
- CRUISING FLIGHT**
Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
- CRYOGENIC COOLING**
Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851
A heat switch for space cryocooler applications p 160 N92-25852
- CRYOGENIC TEMPERATURE**
Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
- CRYOGENIC WIND TUNNELS**
Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model
[ESA-TT-1247] p 48 N92-29159
- CRYOGENICS**
An overview of ESA cryocooler activities p 154 N92-25850
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875
- CRYSTAL DEFECTS**
Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
Observation of inverse domains in high Tc superconductors p 273 A92-52211
- CRYSTAL GROWTH**
Crystal growth experiments on Russian unmanned spacecraft
[IAF PAPER 92-0934] p 151 A92-57307
- CRYSTAL LATTICES**
Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
[PB92-142421] p 273 N92-22738
- CUBIC EQUATIONS**
Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
- CUES**
Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546
Effective cueing during approach and touchdown: Comparison with flight p 117 N92-28552
- CULTURE (SOCIAL SCIENCES)**
Multi-cultural components and keys for European worldwide space programs p 122 N92-27008

CUMULATIVE DAMAGE

- Short cracks and durability analysis of the Fokker 100 wing/fuselage structure
[NLR-TP-90336-U] p 220 N92-29603

CUMULONIMBUS CLOUDS

- Polar lows affecting Denmark p 237 A92-32491

CURRENT SHEETS

- Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574

CURVATURE

- Transition to turbulence in curved channel flow p 18 A92-40125
The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions.
[AD-A243810] p 192 N92-18934
Boundary layer transition on concave surfaces p 195 A92-22200
Boundary layers and transition on concave surfaces p 196 N92-24341

CURVE FITTING

- Dynamic characterization and identification of nonlinear systems application to aeronautical structures p 217 A92-11830

CYCLIC LOADS

- Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles
[ONERA, TP NO. 1992-31] p 218 A92-48592
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
Short cracks and durability analysis of the Fokker 100 wing/fuselage structure
[NLR-TP-90336-U] p 220 N92-29603

CYCLOGENESIS

- The field of potential vorticity during the development of a cyclone
[BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048

CYCLONES

- A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
The field of potential vorticity during the development of a cyclone
[BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048

CYLINDRICAL BODIES

- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds
[ESDU-91004] p 28 N92-11967
Physical and computational modelling of stratified shear flows
[AERO-REPT-8909] p 190 N92-17974
- CYLINDRICAL SHELLS**
Linear panel flutter of an elliptical cylindrical shell p 218 A92-21216

D**DAMAGE**

- Fatigue life behaviour of composite structures p 145 N92-18577
Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005

DAMAGE ASSESSMENT

- Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
Fatigue and damage tolerance verification of aircraft structures p 217 A92-19677
Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
Repair procedures for advanced composites for helicopters p 4 A92-56277
Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241
Repair procedures for advanced composites for helicopters
[MBB-UD-0606-91-PUB] p 5 N92-29874
Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
Damage tolerance and durability evaluation of aluminum-lithium alloys
[PB91-219477] p 150 N92-70307

DAMPING

- A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft
[IAF PAPER 92-0031] p 132 A92-55527
Computation of laminar flow over cavities
[AERO-REPT-9013] p 191 N92-18235

DASSAULT AIRCRAFT

- The DLR meteorological research aircraft Falcon p 240 N92-26348
The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544

DATA ACQUISITION

- Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323
Some important factors in turbulence in flight measurement p 90 A92-54324
Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404

Aircraft tracking for structural fatigue

- p 79 N92-18584
Collection of product assurance data and their effective utilization p 216 N92-18651
The DLR meteorological research aircraft Falcon p 240 N92-26348

- Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment
[BCRS-91-28] p 225 N92-30230

- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle
[MBB/FE202/S/PUB/461] p 5 N92-30232

- Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 N92-32960

DATA BASES

- The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994

- An attempt to unify space terminology - The Multilingual Terminology Data Base
[IAF PAPER 92-0343] p 277 A92-55758

- Some new definitions for the Multilingual Terminology Data Base
[IAF PAPER 92-0359] p 277 A92-55766

- The recovering of flow features from large numerical data bases p 189 N92-16231

- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle
[MBB/FE202/S/PUB/461] p 5 N92-30232

DATA CORRELATION

- Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11
[NLR-TP-90070-U] p 220 N92-28650

DATA LINKS

- Application of VME-technology on an airborne data link processor unit
[NLR-MP-88040-U] p 66 N92-29615

DATA MANAGEMENT

- Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661
The requirements and management of quality audits and reviews
[PNR-90840] p 275 N92-20458

DATA PROCESSING

- The new airport aeronautic meteorological codes p 235 A92-13855
Tool supported software development experiences from the EFA project p 256 N92-12451
Integrating machine intelligence into the cockpit to aid the pilot p 252 N92-12533
Avionics standardization in Europe p 91 N92-14050
A concept for the revisions of structural inspection schedules p 215 N92-14431
The recovering of flow features from large numerical data bases p 189 N92-16231
Aircraft tracking for structural fatigue p 79 N92-18584

- Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317

- ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679

- Integrated Target Acquisition and Fire Control Systems
[AGARD-CP-500] p 92 N92-32437

DATA PROCESSING EQUIPMENT

- Implications of interoperability and standardization for the industrial base p 92 N92-14057

DATA RECORDING

- The SAS Flight Analysis and Aircraft Monitoring System p 89 A92-35941

DATA REDUCTION

- Aircraft tracking optimization of parameters selection
p 79 N92-18585

DATA SIMULATION

- Simulations of SAR imaging of ship wakes, comparing
different wind growth rate models p 242 A92-35025
Simulation and control of large software projects
p 258 N92-20615

DATA STRUCTURES

- A structured tri-tree search method for generation of
optimal unstructured finite element grids in two and three
dimensions p 172 A92-37388
Mesh adaptivity with the quadtree method
p 22 A92-47041

- The construction, application and interpretation of
three-dimensional hybrid meshes p 263 A92-47089

DATA SYSTEMS

- CFD efforts in the Netherlands
[NLR-TP-91250-U] p 205 N92-32835

DATA TRANSMISSION

- Future developments in aeronautical satellite
communications p 158 N92-24167

DECCA NAVIGATION

- Accurate current measurement using drogued buoys
employing Decca Navigator and Argos
p 241 A92-12278

DECELERATION

- Advanced carbon/carbon planetary entry decelerator
development and hardware verification
[IAF PAPER 92-0327] p 128 A92-55748
Blade instability of horizontally stoppable rotors
p 106 A92-56308
Separation of relaminarised boundary layers
[CUEA/A-AERO/TR-16] p 195 N92-22209

DECISION MAKING

- Cognitive quality and situational awareness with
advanced aircraft attitude displays p 251 A92-11131
Decision support in the cockpit - Probably a good
thing? p 251 A92-11135
The importance of the Type II error in aviation safety
research p 250 A92-13027
Real-time mechanisms in a multibase knowledge
system p 264 A92-20345
Development of tactical decision aids
p 90 N92-12532
Reasoning with uncertain and incomplete information
in aerospace applications p 261 N92-12544
Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant
p 66 N92-27895

DECOMPRESSION SICKNESS

- High Altitude and High Acceleration Protection for
Military Aircrew
[AGARD-CP-516] p 247 N92-18972

DEEP SPACE NETWORK

- Operational aspects of spacecraft autonomy
p 131 A92-24207

DEFECTS

- The role of crack growth in defect assessment
[PNR-90798] p 220 N92-20909
Application of eddy current techniques to graphite
composite materials
[ETN-92-90815] p 145 N92-21416

DEFENSE INDUSTRY

- Procurement doubts threaten research
p 275 A92-47974

DEFENSE PROGRAM

- The ASMP program p 3 A92-41823
The Conflicting Forces Driving Future Avionics
Acquisition
[AGARD-LS-176] p 91 N92-14046

DEFINITION

- Issues involved in defining outer space, space object
and space debris p 282 A92-51856

DEFLECTION

- Hypersonic inviscid flow field simulations around reentry
vehicles with flap deflection p 38 N92-15025
Lift and rolling moment due to spoilers on wings with
trailing-edge flaps deflected at subsonic speeds
[ESDU-92002-SUPPL] p 51 N92-32782

DEForestation

- Examination and mapping of forest damage using
remote sensing methods
[ETN-92-91913] p 225 N92-33691

DEFORMATION

- High temperature processing and deformation of a
near-alpha titanium alloy
[PNR-90853] p 149 N92-20911
Unsteady transonic aerodynamics of pointed bodies of
revolution in supersonic freestream p 45 N92-27946

DEGREES OF FREEDOM

- Nine-degree-of-freedom simulation of rotating parachute
systems p 55 A92-56155
On the analysis of liquid filled free-free tanks
p 196 N92-23843

DEICERS

- Aircraft icing
[ONERA, TP NO. 1991-202] p 54 A92-26359
Effect of a deicing device on the induced drag of a lifting
airfoil p 74 A92-51947
Effects of Adverse Weather on Aerodynamics
[AGARD-CP-496] p 55 N92-21679
Aerodynamic effects of de/anti-icing fluids and
description of a facility and test technique for their
assessment p 56 N92-21697

DEICING

- Flying on thin ice p 54 A92-38375
Preparation of the ice certification of the Dornier 328
regional airliner by numerical simulation and by ground
test p 56 N92-21693
Analysis of three icing test flights reaching the
aircraft-referred icing degree of severe
[ESA-TT-1254] p 58 N92-31943

DELAMINATING

- Dispersion curves analysis for bonded plates at low
F_d p 217 A92-13540
Application of MSC/DYNA to shock and impact
problems in aircraft industry
[MBB-UD-0593-91-PUB] p 219 N92-14382

DELTA WINGS

- Secondary separation from a slender wing
p 6 A92-13448
Numerical investigation into high-angle-of-attack
leading-edge vortex flow
[AIAA PAPER 92-2600] p 20 A92-45477
Experimental investigation of vortex dynamics on delta
wings
[AIAA PAPER 92-2731] p 21 A92-45565
Hypersonic flow calculations around a 3D delta wing
at low Knudsen numbers p 25 A92-52734
Heat transfer to a delta wing and two waverider wings
in rarefied hypersonic flow p 25 A92-52748
Nonstationary flight aerodynamics in a turbulent
environment
[ETN-91-90102] p 29 N92-11980
Performance improvements and fuel cost savings due
to leading edge modification of a vintage delta wing jet
fighter
[FFA-TN-1991-22] p 76 N92-11993
Comparison of solution of various Euler solvers and one
Navier-Stokes solver for the flow about a sharp-edged
cropped delta wing
[AD-B163639L] p 30 N92-12998
Vortical flow simulation by using structured and
unstructured grids p 30 N92-12999
Analysis of results of an Euler-equation method applied
to leading-edge vortex flow p 30 N92-13000
Experimental and numerical investigation of the vortex
flow over a delta wing at transonic speed
p 30 N92-13001

- On the simulation of compressible turbulent flows past
delta wing, delta wing-body and delta wing-canard
p 31 N92-13003

- Vortex formation over a close-coupled canard-wing-body
configuration in unsymmetrical flow p 31 N92-13010
An experimental study of the flow over a sharp-edged
delta wing at subsonic and transonic speeds
p 31 N92-13011

- Hypersonic flow past delta wing flow simulated by
Navier-Stokes solutions p 34 N92-14981
Wind tunnel force measurements and visualization on
a 60-deg delta wing in oscillation, stepwise motion, and
gusts p 80 N92-18786

- Numerical simulation of vortical flow over a delta wing
at subsonic and transonic speeds
[NLR-TP-90029-U] p 41 N92-20498

- Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes
calculation p 42 N92-22181

- Case 7.4 delta wing: Navier-Stokes calculation
p 42 N92-22182

- Hypersonic laminar flow computations over a blunt
leading edged delta wing at three different chord Reynolds
numbers
[FFA-TN-1991-40] p 43 N92-23168

- Normal force of low aspect ratio wing-body combinations
up to high angles of attack at supersonic speeds
[ESDU-91042] p 84 N92-24009

- Analysis of results of an Euler-equation method applied
to leading-edge vortex flow
[NLR-TP-90368-U] p 47 N92-28657

- An experimental study of the flow over a sharp-edged
delta wing at subsonic and transonic speeds
[NLR-TP-91117-U] p 51 N92-32732

- Aspects of the application of a Euler-equation method
to the simulation of leading-edge vortex flow
[PB92-138718] p 53 N92-70577

- Investigation of the low speed flow about a straked delta
wing oscillating in pitch. Part 1: Windtunnel, model, and
test program
[PB92-138676] p 53 N92-70590

DEMAND (ECONOMICS)

- Twilight of the machine builders p 279 A92-20515

DENSITY DISTRIBUTION

- Fiat planes in rarefied hypersonic flows
[SESSIA-430/91-940] p 29 N92-11979
Marching with the parabolized Navier-Stokes equations.
Problem 2: Hypersonic viscous flow over a flat plate
[AERO-REPT-9008] p 40 N92-18232

DENSITY MEASUREMENT

- Instantaneous measurement of density from double
simultaneous interferograms p 207 A92-45129

DEPTH MEASUREMENT

- Seaborne lidar system p 224 N92-23389

DESCENT

- Aerostat for the Mars 1994/1996 mission
p 285 N92-24642

DESCENT TRAJECTORIES

- Modelling of aerodynamic forces and heat transfer for
orbital decay and reentry calculations
p 134 N92-23974

DESCRIPTIONS

- An attempt to unify space terminology - The Multilingual
Terminology Data Base
[IAF PAPER 92-0343] p 277 A92-55758
Some new definitions for the Multilingual Terminology
Data Base
[IAF PAPER 92-0359] p 277 A92-55766

DESIGN ANALYSIS

- The design and testing of a radial flow turbine for
aerodynamic research
[ASME PAPER 91-GT-220] p 93 A92-15636
Design and performance of advanced blading for a
high-speed HP compressor
[ASME PAPER 91-GT-374] p 9 A92-15718
Parametric aerodynamic design of spinning finned
projectiles using a matrix interpolation method
p 12 A92-24655

- Single alexandrite laser source for airborne DIAL
system p 210 A92-51228

- Organization and technical status of the NH90 European
helicopter programme p 4 A92-56306

- Technology exploitation for in-service support of future
rotorcraft p 4 A92-56327

- The design of spaceborne synthetic aperture radar
[ETN-91-99986] p 156 N92-10114

- The turbomachine blading design using S2-S1
approach p 97 N92-13940

- Extended mapping and characteristics techniques for
inverse aerodynamic design p 76 N92-13949

- Application of direct inverse analogy method (DIVA) and
viscous design optimization techniques
p 33 N92-13951

- Analysis tools of ONERA and DLR for the
aerothermodynamics of reentry vehicles
p 133 N92-14977

- Aerothermodynamic challenges of the Saenger
space-transportation system p 39 N92-15042

- Advanced tactical fighter engine
[ETN-92-90840] p 97 N92-18728

- Design principles of automation aids for ATC approach
control p 62 N92-19042

- Integrated Design Analysis and Optimisation of Aircraft
Structures
[AGARD-R-784] p 83 N92-23227

- The structural optimization system OPTSYS: Current
status and applications p 83 N92-23232

- First approach to an integrated fin design
p 83 N92-23236

- Structural optimization of aircraft practice and trends
p 83 N92-23239

- Special Course on Engineering Methods in Aerodynamic
Analysis and Design of Aircraft
[AGARD-R-783] p 83 N92-23950

- Introduction to Special Course on Engineering Methods
in Aerodynamic Analysis and Design of Aircraft
p 84 N92-23951

- Computational procedures for preliminary design
p 84 N92-23952

- Panel methods for aerodynamic analysis and design
p 84 N92-23955

- Space electronic display panel p 278 N92-25787

- Integrated Design Analysis and Optimisation of Aircraft
Structures
[AGARD-LS-186] p 85 N92-28469

- Fundamentals of structural optimisation
p 86 N92-28470

- Practical architecture of design optimisation software for
aircraft structures taking the MBB-Lagrange code as an
example p 86 N92-28471

- Structural optimization of aircraft p 86 N92-28472

- Mathematical optimization: A powerful tool for aircraft
design p 86 N92-28474

- Technology programme: Aerothermodynamics and
propulsion integration. Numerical and experimental
aerothermodynamics
[MBB-FE-202-S-PUB-0464-A] p 48 N92-29648

- Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650
- ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515
- Global/local interlaminar stress analysis of a grid-stiffened composite panel [NASA-CR-190822] p 221 N92-33139
- DESIGN TO COST**
- Keys to excellence in design and manufacture [PNR-90781] p 276 N92-20927
- DESTRUCTION**
- Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
- DETECTION**
- On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 N92-29703
- DEUTERIUM**
- Modelling compressible turbulent mixing p 178 A92-45094
- DEVELOPING NATIONS**
- Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- DICTIONARIES**
- Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762
- Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764
- Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773
- DIFFERENCE EQUATIONS**
- A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866
- DIFFERENTIAL CALCULUS**
- Differential forms and fluid dynamics p 176 A92-42535
- DIFFERENTIAL EQUATIONS**
- Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 N92-23251
- DIFFERENTIAL INTERFEROMETRY**
- Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- DIFFRACTION PATTERNS**
- Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- DIFFUSERS**
- An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206
- DIFFUSION COEFFICIENT**
- On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
- DIFFUSION FLAMES**
- The coherent flamelet model for propulsion applications p 147 N92-27486
- Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames [ETN-92-92103] p 205 N92-33916
- DIFFUSION THEORY**
- Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- DIGITAL COMPUTERS**
- Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340
- DIGITAL DATA**
- The SAS Flight Analysis and Aircraft Monitoring System p 89 A92-35941
- DIGITAL SIMULATION**
- Status and user characterization of parallel machines for digital simulation p 260 A92-23046
- Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
- Transition to turbulence in curved channel flow p 18 A92-40125
- A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300
- The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
- Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164
- Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
- Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313
- A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
- Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235
- Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds [NLR-TP-90029-U] p 41 N92-20498
- Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703
- Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721
- DIGITAL SYSTEMS**
- JAS 39 Gripen progress report p 67 A92-16058
- Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
- Flight simulation and digital flight controls p 115 N92-28526
- DIGITAL TECHNIQUES**
- Computation of aircraft noise exposure using digitized topography data p 227 A92-39058
- Advanced method for single event aircraft noise analysis p 266 A92-39060
- DIHEDRAL ANGLE**
- Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- DILUTION**
- Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
- DIPOLLES**
- The Venusian polar dipole p 285 A92-30456
- DIRECTIONAL CONTROL**
- Fuzzy guidance system evaluation p 259 N92-27903
- DIRECTIVITY**
- Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- DIRICHLET PROBLEM**
- Two-point optimization of complete three-dimensional airplane configuration [AIAA PAPER 92-2618] p 73 A92-45491
- Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
- Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
- A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 N92-14321
- DISKS (SHAPES)**
- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
- Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770
- DISORDERS**
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 N92-13547
- DISORIENTATION**
- Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382
- G-tolerance and spatial disorientation: Can simulation help us? p 248 N92-28534
- DISPENSERS**
- Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
- DISPERSING**
- Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- DISPLACEMENT**
- Direct coupling of fluid structure in transonic aeroelasticity p 46 N92-27954
- DISPLAY DEVICES**
- Flying the A340 iron bird p 67 A92-10666
- Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
- Tomorrow's cockpit displays p 88 A92-13699
- Concept for future cockpits p 88 A92-16148
- Flight management system back-up navigation for the A330/A340 aircraft p 106 A92-49326
- Quick-look system p 224 N92-23393
- Space electronic display panel p 278 N92-25787
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546
- DISSIPATION**
- Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507
- Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 N92-29213
- Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 N92-29977
- DISSOCIATION**
- Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
- DISSOLVING**
- Melting and dissolving p 178 A92-46260
- DISTANCE**
- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- DISTANCE MEASURING EQUIPMENT**
- DME growth elements and their use with MLS p 62 N92-14018
- DISTORTION**
- Boundary layer transition on concave surfaces p 195 N92-22200
- DISTRIBUTED PROCESSING**
- From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368
- DO-28 AIRCRAFT**
- The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 N92-31813
- DOCUMENTATION**
- Normalization, reliability and validation of information for spatial operations p 157 N92-15285
- DOCUMENTS**
- Commission for Aeronautical Meteorology. Abridged final report of the ninth session [WMO-752] p 240 N92-18911
- Aeronautical Engineering Group publications, 1950 - present [AERO-REPT-8907] p 202 N92-29683
- DOPPLER RADAR**
- Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 N92-14268
- Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
- The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300
- Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- DORNIER AIRCRAFT**
- Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
- Dornier 328 - A Daimler for commuters p 69 A92-30091
- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- Preconsiderations on aircraft integration p 224 N92-23402
- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3 p 84 N92-25591
- DOSIMETERS**
- LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231
- DRAG**
- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution [ESDU-91029] p 39 N92-15973
- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249
- DRAG REDUCTION**
- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- The design and testing of an airfoil with hybrid laminar flow control [ONERA, TP NO. 1992-22] p 24 A92-48585
- The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
- Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 N92-27706

- Basic concepts on boundary layers p 44 N92-27707
- Drag reduction: An industrial challenge p 44 N92-27708
- Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711
- Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 N92-28660
- DROPS (LIQUIDS)**
- A new thermometric instrument for airborne measurements in clouds p 88 A92-24918
- A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
- DROPSONDES**
- Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902
- DUCT GEOMETRY**
- Computational modelling of turbulent flow in S-bends p 199 N92-27480
- Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464
- DUCTED FAN ENGINES**
- Conception of a UHB engine simulator for the essential characteristics of a true-scale engine --- ultrahigh bypass p 112 A92-54322
- DUCTED FLOW**
- Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
- Noise-driven flow p 10 A92-18680
- Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604
- CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450
- Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- Computational modelling of turbulent flow in S-bends p 199 N92-27480
- Three dimensional flow in sharp bends --- ducted flow p 200 N92-27481
- DUCTS**
- Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476
- Computational modelling of turbulent flow in S-bends p 199 N92-27480
- DURABILITY**
- Fatigue management for the A-7P p 79 N92-18593
- Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307
- DYNAMIC CHARACTERISTICS**
- Dynamics of vortices in high-temperature superconductors p 273 N92-10501
- Modeling and simulation of complex mechanical systems for space applications p 135 N92-24389
- Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581
- DYNAMIC CONTROL**
- A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
- Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581
- DYNAMIC LOADS**
- Fatigue life analysis for variable-amplitude loading p 218 A92-19697
- Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 N92-15065
- Dynamic load cases on Ariane 5 p 127 N92-23797
- DYNAMIC MODELS**
- Modelling and identification of flexible spacecraft p 131 A92-15409
- A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
- LAH main rotor model test at the DNW p 70 A92-35771
- Simulation of helicopter see-saw rotor motion p 74 A92-56287
- On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973
- Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators [NLR-TP-90028-U] p 261 N92-28648

- DYNAMIC PROGRAMMING**
- Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
- A constraint satisfaction approach to operative management of aircraft routing p 54 A92-25181
- DYNAMIC RESPONSE**
- Hang-glider response to atmospheric inputs p 104 A92-46765
- The dynamic response of separated hypersonic flows p 38 N92-15019
- Dynamic load cases on Ariane 5 p 127 N92-23797
- Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
- DYNAMIC STRUCTURAL ANALYSIS**
- Gust effects on a flexible aircraft p 68 A92-22474
- A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866
- Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000
- Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
- Influence of microvibrations on spacecraft performances p 134 N92-23825
- Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
- On the analysis of liquid filled free-free tanks p 196 N92-23843
- Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 N92-23844
- A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 N92-23846
- The dynamics of the Cluster spacecraft p 137 N92-24510
- Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 N92-28650
- Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 N92-34161
- DYNAMIC TESTS**
- Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793
- DYNAMIC SYSTEMS**
- Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815
- Fluid dynamic forces on tethered satellite systems p 124 A92-52738
- A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182
- Stochastic perturbed systems: Theory and practice of Karman vortex streets [MPIS-4/1991] p 193 N92-20180
- DYNAMICS**
- Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
- Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728

E

- EARTH ALBEDO**
- Interpretation of field measurements made with a portable albedometer p 207 A92-49773
- Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- Low cost spacecraft attitude sensors p 140 N92-24458
- EARTH ATMOSPHERE**
- Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800
- Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge [AD-A241072] p 232 N92-13512
- EARTH CORE**
- On inertial waves in the earth's fluid core p 231 A92-37905
- EARTH ENVIRONMENT**
- Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007
- EARTH GRAVITATION**
- Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808
- EARTH IONOSPHERE**
- Antarctic studies of the cusp p 233 N92-26301

- EARTH MAGNETOSPHERE**
- Signatures of transient boundary layer processes observed with Viking p 230 A92-24532
- Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
- Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 N92-24351
- Antarctic studies of the cusp p 233 N92-26301
- Balloons for conjugate cusp studies in the 1990's p 233 N92-26315
- EARTH OBSERVATIONS (FROM SPACE)**
- The French space program for earth observation p 222 A92-37154
- The Norwegian space programme p 121 A92-53453
- European industrial capabilities to provide meteorological space systems p 228 N92-25238
- The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
- Planetary vision as a strategy p 229 N92-25243
- The role of Belgium in Earth observation from space programs p 229 N92-25245
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
- Space: Part of Europe's environment p 122 N92-70627
- EARTH ORBITAL ENVIRONMENTS**
- The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
- Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560
- Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
- Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings [ISBN 2-85428-288-4] p 131 A92-27130
- The space environment and its effects on spacecraft design p 120 A92-33403
- Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764
- Equilibrium configurations in a tethered atmospheric mission [AAS PAPER 91-543] p 124 A92-43391
- Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
- Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774
- Spacecraft thermal control coatings p 151 N92-24829
- New results from FRECOPA analysis --- long duration exposure facility p 213 N92-27304
- EARTH ORBITS**
- Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
- EARTH RESOURCES**
- The French space program for earth observation p 222 A92-37154
- EARTH SURFACE**
- A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
- The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
- Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
- EARTH TERMINALS**
- The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system p 58 A92-13851
- ECONOMIC ANALYSIS**
- Insurers lose from high-risk deals p 279 A92-35474
- ECONOMIC DEVELOPMENT**
- Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- ECONOMIC FACTORS**
- P120 programme - First results of the pre-development phase p 1 A92-14447
- An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- ECONOMICS**
- Aircraft tracking for structural fatigue p 79 N92-18584

EDDY CURRENTS

Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088

The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 A92-18934

Application of eddy current techniques to graphite composite materials [ETN-92-90815] p 145 A92-21416

EDDY VISCOSITY

Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523

Turbulence - The filtering approach p 175 A92-41656

Towards the computation of turbulent hypersonic flows [AERO-REPT-9106] p 40 A92-18318

On the determination of turbulent mixing coefficients from Eulerian current data p 195 A92-22121

The application of a Navier-Stokes CFD method to civil engine intake flows p 199 A92-27471

A dynamic subgrid-scale eddy viscosity model p 203 A92-30649

EDGE DETECTION

Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943

A frontal approach for node generation in Delaunay triangulations p 201 A92-27680

EDGE LOADING

On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 A92-11973

EDUCATION

Main activities conducted under the International Space Year Panel of Experts on Education and Applications [IAF PAPER 92-0466] p 274 A92-55806

Training guidelines in non-destructive testing techniques [DE92-615083] p 217 A92-23258

International Space University: Experiences and observations during Summer 1989 p 275 A92-25786

EFFECTIVENESS

Opportunities for flight simulation to improve operational effectiveness p 115 A92-28523

EIGENVALUES

Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908

Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704

Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 A92-23844

EIGENVECTORS

Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 A92-12004

EJECTION INJURIES

Injuries associated with the use of ejection seats in Finnish pilots p 247 A92-50292

EJECTION SEATS

JPATS escape system development p 70 A92-35434

Injuries associated with the use of ejection seats in Finnish pilots p 247 A92-50292

EJECTION TRAINING

JPATS escape system development p 70 A92-35434

EKMAN LAYER

The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves p 166 A92-23292

ELASTIC PROPERTIES

Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 A92-21763

ELECTRIC CONNECTORS

Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 A92-27118

ELECTRIC CONTACTS

The stability of graphite brushes at high velocity [ETN-91-90176] p 160 A92-12184

ELECTRIC DISCHARGES

Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678

ELECTRIC GENERATORS

Power system performance prediction for the Hipparcos spacecraft p 141 A92-13155

ELECTRIC NETWORKS

Vortex dynamics in artificially fabricated superconducting networks [ETN-92-91296] p 160 A92-25307

ELECTRIC POTENTIAL

A method for determining the potential of a spacecraft p 131 A92-23433

Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 A92-27148

ELECTRIC PROPULSION

Benefits of electric propulsion for orbit injection of communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709

Advanced spacecraft concepts using electrical propulsion [AIAA PAPER 92-3513] p 132 A92-49046

ELECTRIC WIRE

Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134

ELECTRICAL ENGINEERING

A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 A92-17434

ELECTRICAL GROUNDING

Oxygen isotopes implanted in the LDEF spacecraft p 272 A92-27284

ELECTRICAL MEASUREMENT

A method for determining the potential of a spacecraft p 131 A92-23433

The role of crack growth in defect assessment [PNR-90798] p 220 A92-20909

ELECTRICAL RESISTIVITY

Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088

Vortex dynamics in artificially fabricated superconducting networks [ETN-92-91296] p 160 A92-25307

ELECTRO-OPTICS

Fixed wing night attack EO integration and sensor fusion p 253 A92-19009

ELECTROACOUSTICS

Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363

ELECTROCHEMICAL CELLS

Different space electrochemical conversion and storage systems p 140 A92-40455

ELECTROENCEPHALOGRAPHY

EEG as screening method in aeromedical selection of air crew p 246 A92-16408

ELECTROMAGNETIC COMPATIBILITY

Spacecraft electromagnetic compatibility engineering p 132 A92-33417

Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315

ELECTROMAGNETIC FIELDS

The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136

Some direct methods in electromagnetism p 265 A92-47921

ELECTROMAGNETIC INTERFERENCE

Spacecraft electromagnetic compatibility engineering p 132 A92-33417

ELECTROMAGNETIC NOISE

Jet aircraft noise at high subsonic flight Mach numbers [DLR-FB-91-28] p 270 A92-29997

ELECTROMAGNETIC PULSES

Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301

ELECTROMAGNETIC SPECTRA

Sensor compatibility/optimal sensor combinations p 224 A92-23403

ELECTROMAGNETISM

Some direct methods in electromagnetism p 265 A92-47921

ELECTROMECHANICAL DEVICES

Experiences in the development of rotary joints for robotic manipulators in space applications p 213 A92-25073

ELECTROMETERS

Low pressure impactor with electrical concentration detection p 209 A92-10534

ELECTROMYOGRAPHY

Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 A92-19926

ELECTRON GAS

Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897

ELECTRON SPECTROSCOPY

The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415

ELECTRON-POSITRON PAIRS

Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523

ELECTRON-POSITRON PLASMAS

Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma [DE92-614464] p 284 A92-22653

ELECTRONIC CONTROL

Electronically steerable antenna for aircraft p 156 A92-15272

ELECTRONIC EQUIPMENT

Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826

The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 A92-10997

Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 A92-12517

ELECTRONIC EQUIPMENT TESTS

Test Engineering Language for Avionic Systems p 89 A92-35763

Aeronautical satellite system test and implementation p 158 A92-24095

Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 A92-24474

ELECTRONIC MODULES

Applications of silicon hybrid multi-chip modules to avionics p 92 A92-28379

ELECTRONIC TRANSDUCERS

Study of interactions on anemoclinometric sensors [REPT-90/30] p 113 A92-12006

ELECTRONIC WARFARE

AGARD highlights 91/2 [ISBN-92-835-0634-0] p 286 A92-13916

ELECTROPHORESIS

High performance capillary electrophoresis in microgravity environment p 206 A92-20996

ELEVATORS (CONTROL SURFACES)

The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 A92-31813

ELLIPSOIDS

Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 A92-15030

Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 A92-22181

Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation p 42 A92-22183

ELLIPTIC DIFFERENTIAL EQUATIONS

Concerning the functional solution of transonic flows p 11 A92-21318

Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 A92-30372

EMBEDDED COMPUTER SYSTEMS

Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839

A practical experience of Ada for developing embedded software p 257 A92-12465

EMISSION SPECTRA

Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 A92-27108

EMISSION

Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124

END EFFECTORS

Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704

ENERGY BUDGETS

Turbulent energy budgets in impinging zones p 17 A92-40081

The stratospheric residual circulation as deduced from satellite data p 232 A92-14498

ENERGY CONSERVATION

Heat pump systems with direct expansion ground coils [DE92-007831] p 195 A92-23120

ENERGY CONVERSION

Different space electrochemical conversion and storage systems p 140 A92-40455

ENERGY DISSIPATION

Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483

The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves p 166 A92-23292

Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146

ENERGY LEVELS

Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 A92-26507

ENERGY METHODS

Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers [ESDU-91016-ADD] p 77 N92-15987

ENERGY SPECTRA

A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
Atmospheric turbulence spectra and correlation functions [NLR-TP-89217-U] p 234 N92-28689

ENERGY STORAGE

Different space electrochemical conversion and storage systems p 140 A92-40455

ENERGY TECHNOLOGY

SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Ecole Supérieure d'Electricité, Gif-sur-Yvette, France, Aug. 27-30, 1991 p 226 A92-40401

ENERGY TRANSFER

Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317
The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 N92-27049
Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475

ENGINE AIRFRAME INTEGRATION

Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
EUROFAR airframe aerodynamic design p 70 A92-35750

Evolution of ASTOVL aircraft design

p 72 A92-45311
ASTOVL engine control p 95 A92-45321
Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 N92-24411

ENGINE CONTROL

The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023
ASTOVL engine control p 95 A92-45321
Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
Parallel processing applications for gas turbine engine control p 96 N92-11012
Software methodologies for safety critical systems p 257 N92-12467
ASTOVL engine control [PNR-90808] p 100 N92-27040

ENGINE COOLANTS

Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667

ENGINE DESIGN

Three dimensional flow in a linear compressor cascade at design conditions [ASME PAPER 91-GT-114] p 8 A92-15565
The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
The engine inside p 94 A92-36126
VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306
Hot-gas reingestion - Engine response considerations p 95 A92-45317
CIS engines. I - The range revealed p 4 A92-47821
'A new proposal for an old problem - The right engine for the right helicopter p 96 A92-56281
Advanced tactical fighter engine [ETN-92-90840] p 97 N92-18728
Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005
Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 N92-20179
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 N92-20573
Compressing the compressor p 99 N92-21848
The evolution of the bypass engine [PNR-90832] p 99 N92-21850

Impact of regulation changes on engine design and certification

[PNR-90789] p 99 N92-22098
VSTOL engine design evolution: Growth of the Pegasus engine for Harrier

[PNR-90805] p 99 N92-27039

ASTOVL engine control [PNR-90808] p 100 N92-27040

The changing role of experimentation in aeroengine R and D: The point of view of the research worker

[AD-A246372] p 100 N92-27062

Steady and Transient Performance Prediction of Gas Turbine Engines

[AGARD-LS-183] p 101 N92-28458

Practical considerations in designing the engine cycle p 102 N92-28460

Re-engining for real stage 3 compliance [PNR-90872] p 102 N92-33748

The Rolls-Royce Trent [PNR-90875] p 88 N92-33750

ENGINE FAILURE

Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
ETOPS: A developing scene [PNR-90844] p 98 N92-20459

ENGINE INLETS

The computation of three-dimensional flows using unstructured grids p 16 A92-37539
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 N92-20573
Air intakes for high speed vehicles [AGARD-AR-270] p 41 N92-20797
The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
Computational modelling of turbulent flow in S-bends p 199 N92-27480

ENGINE MONITORING INSTRUMENTS

A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
The use of optical sensors and signal processing gas turbine engines p 90 A92-46247

ENGINE NOISE

Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353
NASA's quiet side. I p 3 A92-37875
The interaction between a high-frequency gust and a blade row p 267 A92-54484
Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169

ENGINE PARTS

Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 N92-27062
Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422
Calculation of installation effects within performance computer programs p 102 N92-28465

ENGINE TESTS

French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683
Conception of a UHB engine simulator for the essential characteristics of a true-scale engine --- ultrahigh bypass p 112 A92-54322
Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076
VSTOL engine design evolution: Growth of the Pegasus engine for Harrier [PNR-90805] p 99 N92-27039
The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 N92-27062

ENGINEERING MANAGEMENT

BA's 777 p 74 A92-51580
Concurrent engineering p 260 N92-30952

ENGLISH LANGUAGE

Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773

ENTHALPY

High enthalpy nozzle flows p 36 N92-15000

ENTROPY

Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815
Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822
Entropy production in gaseous boundary layers p 183 A92-52814

ENVIRONMENT EFFECTS

Environmental impact of a future supersonic transport aircraft [ONERA, TP NO. 1991-132] p 226 A92-16108
Supersonic transport in the 21st century p 2 A92-26793
The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574
Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
The impact of air transport on the environment [PNR-90876] p 230 N92-33751

ENVIRONMENT MANAGEMENT

Environmentally sound [PNR-90776] p 228 N92-21743
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 N92-24351
The role of Belgium in Earth observation from space programs p 229 N92-25245

ENVIRONMENT POLLUTION

A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 N92-22406
The impact of air transport on the environment [PNR-90876] p 230 N92-33751

ENVIRONMENT SIMULATION

Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722

ENVIRONMENTAL CONTROL

Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
Moon base habitability aspects p 254 N92-27026

ENVIRONMENTAL MONITORING

The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
Planetary vision as a strategy p 229 N92-25243
The role of Belgium in Earth observation from space programs p 229 N92-25245
The main lines of the research programs remote sensing: Climate and environment [BCRS-91-25] p 230 N92-29499

ENVIRONMENTAL TESTS

Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
Spacecraft thermal control coatings p 151 N92-24829
The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853
Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048

EPILEPSY

EEG as screening method in aeromedical selection of air crew p 246 A92-16408

EPOXY MATRIX COMPOSITES

An integrated approach to developing tough epoxies p 145 A92-51563

EPOXY RESINS

An integrated approach to developing tough epoxies p 145 A92-51563

EQUATIONS OF MOTION

Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
General model of isolated helicopter blade for stability investigation p 71 A92-35774

- Well-posedness in the generalized sense for the incompressible Navier-Stokes equation p 262 A92-37789
- Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547
- Aircraft stabilization at large angles of attack p 105 A92-47785
- Numerical simulation of vortex street-edge interaction p 33 N92-13027

EQUILIBRIUM EQUATIONS

- Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030

EQUILIBRIUM FLOW

- Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 N92-14325
- Dynamic solder management [AD-A250564] p 150 N92-29647

EQUILIBRIUM METHODS

- Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia --- aircraft models applied to real aircraft p 217 A92-12346

EROSION

- Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

ERROR ANALYSIS

- New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
- Error analysis of the COSPAS SARSAT system p 129 A92-21288
- How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607
- Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
- Local error growth in a barotropic model p 239 A92-52941
- Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 N92-28650
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870

ERS-1 (ESA SATELLITE)

- Activities report of the Netherlands Remote Sensing Board (with abridged version) [ETN-92-91352] p 225 N92-29688

ESCAPE CAPSULES

- US Navy revisits escape modules p 73 A92-47975

ESCAPE SYSTEMS

- JPATs escape system development p 70 A92-35434

ESSENTIALLY NON-OSCILLATORY SCHEMES

- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 N92-27678

ESTIMATES

- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988

ESTIMATING

- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 N92-17853

EULER EQUATIONS OF MOTION

- Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
- Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139
- A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
- On the Arnol'd stability criterion for steady-state flows of an ideal fluid p 165 A92-21506
- Recent progress in reactive flow computations p 167 A92-26220
- Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
- A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
- An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
- Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897

- Numerical predictions of transonic viscous flows around aeroflows through an Euler/boundary layer interaction method p 18 A92-40600
- An unfactored implicit scheme for 3D inviscid transonic flows [AIAA PAPER 92-2668] p 20 A92-45523
- Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038
- Mesh adaptivity with the quadtree method p 22 A92-47041
- Unstructured multigriding by volume agglomeration - Current status p 179 A92-47157
- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
- From vortex layers to vortex sheets p 181 A92-50108
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
- Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
- Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164
- Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 N92-10988
- Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 N92-12998
- Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000
- Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 N92-13018
- Blade design and analysis using a modified Euler solver p 97 N92-13952
- A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
- A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
- Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
- Fast finite element solvers for reentry flows p 35 N92-14988
- Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989
- Numerical simulations around models in hypersonic wind tunnels p 36 N92-14998
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 N92-15025
- Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030
- Grid impact on 3D hypersonic flows p 39 N92-15041
- A linearised Riemann solver for Godunov-type methods [CRANFIELD-AERO-9116] p 265 N92-19924
- Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784
- On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
- Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 N92-22179
- Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation p 42 N92-22183
- Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 N92-23251
- Cell vertex methods for compressible gas flows p 197 N92-26599
- On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
- Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- Nonequilibrium 3D flows of air through inlets p 200 N92-27487

- Unstructured grid methods for compressible flows p 201 N92-27676
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657
- Development and validation of a characteristic boundary condition for a cell-centered Euler method [NLR-TP-90144-U] p 47 N92-28692
- Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712
- Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 N92-30514
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB-FE211/S/PUB/466] p 204 N92-30674
- CFD contributions during hypersonic airplane intake design [MBB-FE213/S/PUB/459] p 50 N92-30676
- EULER-LAGRANGE EQUATION**
- Numerical simulation of vortex street-edge interaction p 33 N92-13027
- Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators [NLR-TP-90028-U] p 261 N92-28648
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767
- EUROPE**
- Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134
- Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827
- Avionics standardization in Europe p 91 N92-14050
- EC funding of collaborative research projects [PNR-90833] p 279 N92-21851
- EUROPEAN AIRBUS**
- Flying the A340 iron bird p 67 A92-10666
- The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
- The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
- Airbus - The family expands p 2 A92-30092
- ELS for the A340 --- Electronic Library System [SAE PAPER 912111] p 89 A92-39963
- Assembling the future p 3 A92-44895
- A340 handling, cockpit design improve on predecessor A320 p 73 A92-47969
- Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
- EUROPEAN SPACE AGENCY**
- In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
- Operational aspects of spacecraft autonomy p 131 A92-24207
- The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing p 223 A92-44167
- European Space Agency - Achievements and perspectives p 121 A92-53459
- Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- ESA power standard p 141 N92-13174
- Aerothermodynamic challenges for ESA programmes p 34 N92-14974
- Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- Catalogue of ESA patents [ESA-SP-1131-REV-1] p 287 N92-19411
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
- EUROPEAN SPACE PROGRAMS**
- Aerothermodynamic challenges for ESA programmes p 34 N92-14974
- Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961
- Quality assurance requirements for ESA space systems [ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- Espace: Sounding rocket and balloon facility p 126 N92-20720
- Space: Part of Europe's environment p 122 N92-70627
- EVACUATING (TRANSPORTATION)**
- The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998

EVALUATION

- Evaluation of the COMPAS experimental system
p 63 N92-19044

EVAPORATION

- Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex
p 234 A92-13336

EVAPORATION RATE

- In situ measurements of the ice water content in cirrus clouds
p 236 A92-22952

EVAPORATIVE COOLING

- The transpirator, an efficient and light evaporative cooler for space technology
p 154 N92-26986

EVAPORATORS

- Application of CFD tools in space projects --- computational fluid dynamics
p 197 N92-25897

EVAPOTRANSPIRATION

- The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback
p 237 A92-47345

EXCIMER LASERS

- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO₂ sources
p 212 A92-42142

EXCITATION

- SCOLE dynamic analysis and frequency response using DISTEL software
p 139 N92-70065

EXERCISE PHYSIOLOGY

- Blood lactate during leg exercise in microgravity
p 247 A92-50162

EXHAUST EMISSION

- Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming
p 226 A92-19193

The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology
[PNR-90847] p 228 N92-20574

The environmental challenges for the next supersonic aircraft
[PNR-90782] p 228 N92-20928

Emissions from aircraft: Standards and potential for improvement
[PNR-90768] p 98 N92-21740

Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport
[ETN-92-91056] p 99 N92-22406

The impact of air transport on the environment
[PNR-90876] p 230 N92-33751

EXHAUST GASES

- Configuration effects on the ingestion of hot gas into the engine intake
p 73 A92-45315

EXOBIOLGY

- Changes observed in lymphocyte behavior during gravitational unloading
p 247 A92-52395

A history of the scientific study of living organisms in space
[IAF PAPER ST-92-0022] p 254 A92-57366

EXPECTANCY HYPOTHESIS

- Definition of P.S.D.-design loads for nonlinear aircraft
[PB92-138619] p 88 N92-70575

EXPEDITIONS

- Experiences during a 14 months overwintering with respect to potential human habitation on other planets
[IAF PAPER ST-92-0249] p 244 A92-55688

EXPERIMENT DESIGN

- Testing of an experimental photographic reconnaissance system
p 209 N92-25602

EXPERT SYSTEMS

- A procedure for automated gas turbine blade fault identification based on spectral pattern analysis
[ASME PAPER 91-GT-259] p 214 A92-15661

The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft
p 2 A92-25180

From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot
[ONERA, TP NO. 1991-216] p 260 A92-26368

Optimal measurement and health index selection for gas turbine performance status and fault diagnosis
[ASME PAPER 91-GT-294] p 94 A92-36889

Expert systems for the trouble-shooting and the diagnostics of engines
[AIAA PAPER 92-3327] p 260 A92-48910

Expert system for the Tornado ground-based check-out system
p 91 N92-12536

A knowledge-based assistant for diagnosis in aircraft maintenance
p 5 N92-12538

Reasoning with uncertain and incomplete information in aerospace applications
p 261 N92-12544

AGILE: An expert system for large space project management
p 276 N92-20621

Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs
p 136 N92-24493

Delfi: Design, development, and applicability of expert systems shells
[ISBN-90-6275-734-0] p 259 N92-25306

Air Vehicle Mission Control and Management
[AGARD-CP-504] p 5 N92-27887

Application of knowledge-based systems for diagnosis of aircraft systems
[NLR-TP-90192-U] p 57 N92-28655

Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management
[AGARD-AR-310] p 264 N92-32229

EXPLOSIVE DECOMPRESSION

- French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes
p 252 N92-18994

EXTERNAL STORE SEPARATION

- Separation of external stores: Comparison of results
[F+W-TF-2058] p 85 N92-26944

EXTERNAL STORES

- Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods
[NLR-TP-89119-U] p 47 N92-28659

An investigation into the interface between three closely spaced axis-symmetric bodies at subsonic speed
[CRANFIELD-AERO-9114] p 50 N92-31514

NLR investigations of flutter behaviour of fighter aircraft with external stores
[NLR-TP-91134-U] p 109 N92-32750

EXTRAPOLATION

- Numerical simulations around models in hypersonic wind tunnels
p 36 N92-14998

EXTRATERRESTRIAL ENVIRONMENTS

- Study on the requirements for the installation of a CES and habitability centre
p 254 N92-27007

EXTRATERRESTRIAL LIFE

- Experiences during a 14 months overwintering with respect to potential human habitation on other planets
[IAF PAPER 92-0249] p 244 A92-55688

EXTRATERRESTRIAL RADIATION

- SETI in France
[IAF PAPER 92-1023] p 282 A92-57345

Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings
[ISBN 2-85428-288-4] p 131 A92-27130

Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056)
p 272 N92-27108

EXTRAVEHICULAR ACTIVITY

- Problems experienced by man when constructing giant structures in space
p 251 A92-40438

F**F-16 AIRCRAFT**

- Load monitoring of F-16 A/B aircraft of the RNLAf with a smart electronic device
p 78 N92-18583

Improvement of separations of practice bombs from a multiple bomb adapter
[NLR-TP-90307-U] p 86 N92-28634

Modifications and results of flight tests of a practice bomb adapter
[NLR-TP-90108-U] p 87 N92-28651

F-2 AIRCRAFT

- Four decades of transonic fighter design
p 68 A92-20203

FAILURE

- Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates
[DLR-FB-91-23] p 64 N92-20902

FAILURE ANALYSIS

- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis
[ASME PAPER 91-GT-201] p 214 A92-15624

Effect of a deicing device on the induced drag of a lifting airfoil
p 74 A92-51947

Protection concepts used in spacecraft power systems
p 142 N92-13176

Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements
[MBB-FE202-S-PUB-0453-A] p 145 N92-17310

Fatigue management for the A-7P
p 79 N92-18593

A managerial approach for reliability verification of mechanical equipment
[MBB-UK-0140-PUB] p 275 N92-18634

Reliability modeling of the systems whose components have non-constant failure rate
p 216 N92-18648

Management of navigation means failure in Hermes space vehicle
p 136 N92-24467

Finite element simulation of viscoelastic flow
p 205 N92-34038

FAILURE MODES

- The Utilization of Advanced Composites in Military Aircraft
[AGARD-R-785] p 146 N92-33033

FAR FIELDS

- Prediction of far-field harmonic noise from propellers
[ESDU-91033] p 269 N92-18074

FARADAY EFFECT

- Observation of inverse domains in high T_c superconductors
p 273 A92-52211

FATIGUE (MATERIALS)

- Aerospace Arall - A challenge for the aircraft designer
p 143 A92-10232

Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles
[ONERA, TP NO. 1992-31] p 218 A92-48592

Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP
p 219 N92-14420

Monitoring load experience of individual aircraft
[NLR-TP-90084-U] p 77 N92-15065

Fatigue safety factor: Assessment of associated safety level
p 220 N92-18573

Aircraft tracking for structural fatigue
p 79 N92-18584

Aircraft fatigue management in the Royal Air Force
p 79 N92-18591

Tornado structural fatigue life assessment of the German Air Force
p 79 N92-18592

Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material
[ETN-92-91301] p 84 N92-24966

Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989
[PB92-138650] p 88 N92-70591

FATIGUE LIFE

- Fatigue and damage tolerance verification of aircraft structures
p 217 A92-19677

Fatigue life analysis for variable-amplitude loading
p 218 A92-19697

Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification
p 68 A92-19819

Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information
p 215 A92-51950

A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991
[FFA-TN-1991-24] p 219 N92-12313

Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] p 77 N92-14045

Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] p 219 N92-14397

Fatigue safety factor: Assessment of associated safety level
p 220 N92-18573

Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating
p 78 N92-18574

Fatigue life behaviour of composite structures
p 145 N92-18577

The Operational Loads Monitoring System, OLMS
p 79 N92-18586

Tornado structural fatigue life assessment of the German Air Force
p 79 N92-18592

A fatigue analysis of the TF89 tactical fighter aircraft
[ETN-92-90657] p 81 N92-20795

The changing role of experimentation in aeroengine R and D: The point of view of the research worker
[AD-A246372] p 100 N92-27062

Short cracks and durability analysis of the Fokker 100 wing/fuselage structure
[NLR-TP-90336-U] p 220 N92-29603

Ageing airplane repair assessment program for Airbus A300
p 57 N92-30123

FATIGUE TESTS

- High temperature low cycle fatigue of single crystal nickel base superalloys
p 148 A92-19796

The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads
p 111 A92-21922

Effects of spectrum variations on fatigue crack growth
p 219 A92-57399

A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991
[FFA-TN-1991-24] p 219 N92-12313

Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] p 219 N92-14397

Methodology for assessment of skin repairs on Airbus aircraft
p 219 N92-14428

Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements
[MBB-FE202-S-PUB-0453-A] p 145 N92-17310

Fatigue testing and tear down operations on Airbus A320 forward fuselage
p 78 N92-18579

- Proposal for the new fatigue management system for the AMX p 78 N92-18580
- The G-222 aircraft individual tracking programme p 78 N92-18582
- A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795
- Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 N92-28643
- Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989 [PB92-138650] p 88 N92-70591
- FAULT TOLERANCE**
- Robust flight control systems - A parameter space design p 106 A92-50503
- Parallel processing applications for gas turbine engine control p 96 N92-11012
- Validation of flight critical control systems [AGARD-AR-274] p 108 N92-20026
- FEAR OF FLYING**
- Fear of flying p 251 N92-13556
- FEASIBILITY ANALYSIS**
- Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353
- A knowledge-based assistant for diagnosis in aircraft maintenance p 5 N92-12538
- Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests [ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
- The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728-] p 48 N92-28789
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605
- FEDERAL BUDGETS**
- The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 N92-14046
- FEEDBACK**
- The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758
- The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345
- FEEDBACK CONTROL**
- Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- Aircraft control for take-off in windshear p 104 A92-36990
- Robust flight control systems - A parameter space design p 106 A92-50503
- Reentry control of a low-lift maneuverable spacecraft [AIAA PAPER 92-4455] p 124 A92-55216
- Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
- Code generation for fast DSP-based real-time control p 257 N92-12462
- FERMIONS**
- Exotic states in the cores of quantized vortices for superfluids and superconductors [DE92-728466] p 206 N92-70151
- FIBER COMPOSITES**
- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982
- State of composite material structure control in situ p 215 A92-54862
- Application of eddy current techniques to graphite composite materials p 145 N92-21416
- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
- Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043
- FIBER OPTICS**
- Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773
- Fibre optic rotary position sensors for vehicle and propulsion controls p 90 A92-46243
- FIBER ORIENTATION**
- Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 67 N92-30424

- FIBERS**
- Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966
- FIELD ALIGNED CURRENTS**
- Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
- Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
- Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089
- FIGHTER AIRCRAFT**
- Tomorrow's cockpit displays p 88 A92-13699
- Heavy metal --- fighter aircraft test rigs p 110 A92-18100
- Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 88 A92-19819
- Four decades of transonic fighter design p 68 A92-20203
- The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- The evaluation of canard couplings at high angles of attack [AIAA PAPER 92-0281] p 12 A92-25735
- Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353
- Rafale M - Dassault's Squall at sea p 71 A92-37874
- Rafale: Program update - Development of a naval version p 72 A92-40035
- Knowledge transfer and support systems in fighter aircraft p 251 A92-45047
- Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323
- Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
- Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 N92-12004
- Tool supported software development experiences from the EFA project p 256 N92-12451
- Development of tactical decision aids p 90 N92-12532
- Integrating machine intelligence into the cockpit to aid the pilot p 252 N92-12533
- Implications of interoperability and standardization for the industrial base p 92 N92-14057
- Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 N92-15065
- Aerodynamic development of the X-31 aircraft for the high angle of attack region [MBB-FE211-S-PUB-452] p 77 N92-17313
- Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 N92-18333
- Advanced tactical fighter engine [ETN-92-90840] p 97 N92-18728
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795
- Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 N92-20475
- A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795
- The evolution of the bypass engine [PNR-90832] p 99 N92-21850
- Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544
- NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750
- Aspects of compression in aerospace composites: Future requirements p 146 N92-33036

- FILM COOLING**
- Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
- Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208
- FINANCE**
- EC funding of collaborative research projects [PNR-90833] p 279 N92-21851
- FINANCIAL MANAGEMENT**
- Selected pitfalls and booby-traps in aircraft finance p 280 A92-35587
- Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591
- Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
- Aircraft financing in Spain p 280 A92-35593
- Dutch security rights in aircraft and engines p 280 A92-35594
- MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686
- FINENESS RATIO**
- An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 N92-13015
- FINITE DIFFERENCE THEORY**
- The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171
- Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533
- Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
- Lightning strike simulation using coaxial line technique and 3D linear injection current analysis p 159 A92-20131
- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- Internal flow modelling of vortex throttles p 168 A92-27385
- Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814
- Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study p 178 A92-45603
- An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
- Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089
- Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234
- Tracer transport in the middle atmosphere p 229 N92-26473
- Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- FINITE ELEMENT METHOD**
- Prediction of generalized aerodynamic forces following linearized supersonic theory [ONERA, TP NO. 1991-114] p 9 A92-16093
- Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126
- Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
- Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289
- Recent progress in reactive flow computations p 167 A92-26220
- A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
- A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
- A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504

- Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
- World Congress on Computational Mechanics, 2nd, Universitaet Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers p 262 A92-38401
- Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704
- Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles [ONERA, TP NO. 1992-31] p 218 A92-48592
- Elasto-acoustic damped vibrations - Finite element and modal reduction methods [ONERA, TP NO. 1992-52] p 218 A92-48613
- Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
- Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 A92-10988
- Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 A92-14360
- Fast finite element solvers for reentry flows p 35 A92-14988
- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 A92-14990
- Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-90867] p 192 A92-19349
- Influence of microvibrations on spacecraft performances p 134 A92-23825
- Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 A92-24963
- Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 A92-25959
- Application of finite element method to hypersonic nozzle flow computations p 199 A92-27479
- Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 A92-27671
- Finite element methods for flow problems p 200 A92-27672
- Multidimensional upwind methods for unstructured grids p 201 A92-27675
- Unstructured grid methods for compressible flows p 201 A92-27676
- Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 A92-28471
- Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 A92-28650
- MBB-LAGRANGE: A general structural reliability and optimization structural system p 220 A92-30423
- [MBB/FW321/S/PUB/467] p 270 A92-32952
- Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 A92-32952
- Finite element simulation of viscoelastic flow p 205 A92-34038
- FINITE VOLUME METHOD**
- Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703
- Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
- Cell vertex finite volume discretizations in three dimensions p 168 A92-27475
- Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions [AIAA PAPER 92-2638] p 20 A92-45507
- Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections [AIAA PAPER 92-2653] p 21 A92-45569
- 3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
- Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
- Vortical flow simulation by using structured and unstructured grids p 30 A92-12999
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 A92-13003
- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 A92-14325
- Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 A92-14326
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 A92-14328
- A multiblock flow solver for inviscid hypersonic flows p 34 A92-14986
- Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 A92-20179
- Inviscid drag prediction for transonic transport wings using a full-potential method [NLR-TP-89365-U] p 41 A92-20473
- Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 A92-21704
- Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 A92-22180
- Cell vertex methods for compressible gas flows p 197 A92-26599
- Time-marching methods for secondary flow analysis in curved ducts p 198 A92-27454
- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 A92-27678
- Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 A92-28712
- A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 A92-29972
- Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 A92-30514
- FINLAND**
- Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 A92-25758
- Tasks of the council and general secretary of the Commission for Space Industry (Finland) p 276 A92-25785
- FINIS**
- Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
- Effect of thin fins on isolated tailplane lift-curve slope [ESDU-91009] p 28 A92-11969
- Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack [ESDU-91031] p 39 A92-15971
- First approach to an integrated fin design p 83 A92-23236
- FIRE CONTROL**
- Integrated Target Acquisition and Fire Control Systems [AGARD-CP-500] p 92 A92-32437
- Airborne experimental FLIR program p 93 A92-32447
- FIRE DAMAGE**
- Fokker 50 flameouts in icing conditions p 71 A92-35940
- FIRE EXTINGUISHERS**
- Damping down the fires --- in civil transport aircraft p 53 A92-25075
- Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 A92-32856
- FIRE FIGHTING**
- Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 A92-32856
- FIRE PREVENTION**
- Damping down the fires --- in civil transport aircraft p 53 A92-25075
- An evaluation of in-cabin safety features in passenger aircraft [ETN-92-90656] p 55 A92-20794
- FIRES**
- A fire field model implemented in a parallel computing environment p 166 A92-23252
- Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- FITTING**
- The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 A92-19013
- FIXED WINGS**
- Estimation of airborne performance in landing [ESDU-91032] p 77 A92-15988
- Aircraft Ship Operations [AGARD-CP-509] p 81 A92-21951
- FLAME HOLDERS**
- Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- FLAME PROPAGATION**
- Gravitational effects on flame spreading over thin cylindrical fuel samples p 147 A92-14020
- Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942
- FLAME RETARDANTS**
- Damping down the fires --- in civil transport aircraft p 53 A92-25075
- FLAME STABILITY**
- Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942
- FLAPPING**
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 A92-70561
- FLAPS (CONTROL SURFACES)**
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 A92-15025
- Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds [ESDU-92002-SUPPL] p 51 A92-32782
- FLAT PLATES**
- Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455
- Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055
- Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297
- Boundary layer transition on concave surfaces p 195 A92-22200
- Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 A92-22209
- Flat plates placed in depleted hypersonic flow [SESSIA-430/91.960] p 50 A92-31508
- FLAT SURFACES**
- A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55 p 14 A92-28006
- FLEXIBLE BODIES**
- Gust effects on a flexible aircraft p 68 A92-22474
- On the analysis of liquid filled free-free tanks p 196 A92-23843
- FLEXIBLE SPACECRAFT**
- Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
- A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
- Modelling and identification of flexible spacecraft p 131 A92-15409
- Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410
- Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133
- On the nonlinear adaptive control of a flexible spacecraft p 137 A92-24499
- Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 A92-24504
- FLEXIBLE WINGS**
- Design and manufacturing of torsional flexible blade models p 71 A92-35780
- FLIGHT ALTITUDE**
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946
- Computation of aircraft geometric height under radar surveillance p 61 A92-40239

- Selected models of aircraft navigation space
p 61 A92-45373
- FLIGHT CHARACTERISTICS**
- Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction
p 12 A92-24426
- JAS 39 Gripen flight test report
p 72 A92-40030
- Selected models of aircraft navigation space
p 61 A92-45373
- Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft
p 105 A92-47784
- Aircraft stabilization at large angles of attack
p 105 A92-47785
- Aircraft tracking optimization of parameters selection
p 79 N92-18585
- Manoeuvring Aerodynamics
[AGARD-CP-497]
p 80 N92-18778
- Flight simulation and digital flight controls
p 115 N92-28526
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness
[AGARD-AR-315]
p 118 N92-30769
- A background to the handling qualities of aircraft
[ESDU-92006]
p 109 N92-32780
- FLIGHT CONDITIONS**
- Estimation of airborne performance in landing
[ESDU-91032]
p 77 N92-15988
- Flight in adverse environmental conditions
p 55 N92-21680
- Regulations and their changes for certification of civil aircraft in icing conditions
p 56 N92-21683
- Practical considerations in designing the engine cycle
p 102 N92-28460
- FLIGHT CONTROL**
- VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy
p 103 A92-11561
- An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres
p 103 A92-11595
- JAS 39 Gripen progress report
p 67 A92-16058
- Aircraft ground vibration test by means of flight control surfaces
[ONERA, TP NO. 1991-96]
p 103 A92-16079
- Utilization of a research simulator for the development of new flight control concepts
[ONERA, TP NO. 1991-161]
p 110 A92-16128
- Delivered with feeling --- computer-based design of flight control system for Boeing 777
p 103 A92-16621
- Design of low-sensitivity modalized observers using left eigenstructure assignment
p 104 A92-39908
- RAE Bedford VAAC research project --- VSTOL aircraft advanced flight control
p 104 A92-40039
- Pilot attitudes to cockpit automation
p 250 A92-44926
- A progress report on ASTOVL control concept studies under the VAAC programme
p 104 A92-45319
- Fibre optic rotary position sensors for vehicle and propulsion controls
p 90 A92-46243
- Terminal area traffic management
p 61 A92-50122
- Robust flight control systems - A parameter space design
p 106 A92-50503
- A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight
p 107 A92-56334
- Process/object-oriented Ada software design for an experimental helicopter
p 257 N92-12461
- DME growth elements and their use with MLS
p 62 N92-14018
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems
p 188 N92-15027
- Manoeuvring Aerodynamics
[AGARD-CP-497]
p 80 N92-18778
- Robust control system design with application to high performance helicopters
p 108 N92-19621
- Validation of flight critical control systems
[AGARD-AR-274]
p 108 N92-20026
- Approach and landing guidance
p 65 N92-21960
- FALKE: Winged re-entry vehicle flight control
p 136 N92-24454
- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3
p 84 N92-25591
- ATTAS experimental cockpit and ATMOS for flight control components and systems investigations
p 65 N92-25595
- Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities
[AGARD-AR-311]
p 85 N92-27870
- Air Vehicle Mission Control and Management
[AGARD-CP-504]
p 5 N92-27887
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- Fuzzy guidance system evaluation
p 259 N92-27903
- Flight simulation and digital flight controls
p 115 N92-28526
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool
p 116 N92-28541
- Use of a research simulator for the development of new concepts of flight control
p 116 N92-28543
- The role of systems simulation for the development and qualification of ATTAS
p 117 N92-28548
- Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management
[AGARD-AR-310]
p 264 N92-32229
- FLIGHT CREWS**
- The development of a working model of flight crew underload
p 249 A92-13019
- EEG as screening method in aeromedical selection of air crew
p 246 A92-16408
- Radiation exposure of aircrew
p 246 A92-16409
- Windscreen departure
p 55 A92-42500
- Vigilance of aircrews during long-haul flights
p 247 A92-45021
- Knowledge transfer and support systems in fighter aircraft
p 251 A92-45047
- High Altitude and High Acceleration Protection for Military Aircrew
[AGARD-CP-516]
p 247 N92-18972
- French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes
p 252 N92-18994
- Physiological protection equipment for combat aircraft: Integration of functions, principal technologies
p 252 N92-18996
- Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions
p 252 N92-18999
- G-tolerance and spatial disorientation: Can simulation help us?
p 248 N92-28534
- Flight crew integration in the maintenance chain of a commercial aircraft (A 320)
p 276 N92-30957
- Radiation exposure of civil air carrier crewmembers
[NLRGC/B-1-4/91]
p 249 N92-33908
- FLIGHT ENVELOPES**
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers
[ESDU-91016-ADD]
p 77 N92-15987
- Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities
[AGARD-AR-311]
p 85 N92-27870
- FLIGHT FATIGUE**
- Vigilance of aircrews during long-haul flights
p 247 A92-45021
- FLIGHT FITNESS**
- Spinal X-ray screening of high performance fighter pilots
p 245 A92-15959
- Cardiological aspects of pilot's fitness to fly
p 245 A92-16406
- FLIGHT HAZARDS**
- Aircraft icing
[ONERA, TP NO. 1991-202]
p 54 A92-26359
- Aircraft lightning strikes
[ONERA, TP NO. 1991-204]
p 54 A92-26361
- Flying on thin ice
p 54 A92-38375
- FLIGHT INSTRUMENTS**
- Through the looking glass --- effectiveness of electronic flight instrument systems
p 90 A92-46449
- FLIGHT MANAGEMENT SYSTEMS**
- Behind the screens --- development of Central Flow Management Unit for air traffic control
p 59 A92-25520
- The cockpit of a modern aircraft - The Airbus A340 considered as an example
p 69 A92-26849
- Flight management system back-up navigation for the A330/A340 aircraft
p 106 A92-49326
- Terminal area traffic management
p 61 A92-50122
- Space software is first of all software
p 258 N92-20590
- Flight test of avionic and air-traffic control systems
[ETN-92-91063]
p 65 N92-25590
- Testing of an experimental FMS
p 85 N92-25596
- On board planning of 4D-trajectories
p 66 N92-27897
- FLIGHT MECHANICS**
- Elements of airplane performance --- Book
[ISBN 90-6275-608-5]
p 68 A92-26550
- Mathematical modeling of the flight of passenger aircraft in the case of engine failure
p 105 A92-47777
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics
p 81 N92-18794
- Flight in adverse environmental conditions
p 55 N92-21680
- Aircraft Ship Operations
[AGARD-CP-509]
p 81 N92-21951
- Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities
[AGARD-AR-311]
p 85 N92-27870
- Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics
[MBB/FE211/S/PUB/474]
p 5 N92-30675
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness
[AGARD-AR-315]
p 118 N92-30769
- FLIGHT OPERATIONS**
- Aircraft Ship Operations
[AGARD-CP-509]
p 81 N92-21951
- EH 101 ship interface trials: Flight test programme and preliminary results
p 82 N92-21964
- United Kingdom approach to deriving military ship helicopter operating limits
p 82 N92-21966
- Limitations on helicopter operations in the aeronaval environment
p 82 N92-21973
- Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs
p 136 N92-24493
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- Aircraft ship operations
[AGARD-AR-312]
p 85 N92-28468
- The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations
p 116 N92-28539
- Development of new flight procedures for the Microwave Landing System (MLS)
[NLR-TP-91156-U]
p 66 N92-32830
- FLIGHT PATHS**
- The sonic boom and problems related to supersonic flights of military aircraft
[ONERA, TP NO. 1991-162]
p 9 A92-16129
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers
[ESDU-91016-ADD]
p 77 N92-15987
- COMPAS system concept
p 63 N92-19043
- Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES
p 65 N92-25600
- Board-autonomous flight trajectory measurement by example of an ILS measuring system
p 65 N92-25601
- PROCRU simulation results compared with Metro 2 in-flight ILS approach data
[PB92-138502]
p 67 N92-70564
- FLIGHT PLANS**
- Aviation meteorology
p 237 A92-38383
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- FLIGHT RECORDERS**
- The SAS Flight Analysis and Aircraft Monitoring System
p 89 A92-35941
- Aircraft tracking for structural fatigue
p 79 N92-18584
- FLIGHT SAFETY**
- The importance of the Type II error in aviation safety research
p 250 A92-13027
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment
p 59 A92-24946
- Aircraft lightning strikes
[ONERA, TP NO. 1991-204]
p 54 A92-26361
- Aviation meteorology
p 237 A92-38383
- Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990
[ISBN 0-903409-78-X]
p 54 A92-39301
- Engine reliability
p 95 A92-39309
- Aircraft tracking for structural fatigue
p 79 N92-18584
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations
p 252 N92-19000
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics
p 56 N92-21692
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part I: Overview of organisation, techniques employed, and conclusions
[NLR-TP-91062-U-PT-1]
p 66 N92-29605
- On the optimization of windshear warning and guidance systems
[NLR-TP-90196-U]
p 57 N92-29703
- FLIGHT SIMULATION**
- Human resource management in aviation --- Book
p 250 A92-13837
- The use of inverse simulation for conceptual design
p 70 A92-35738

- Pragmatic simulation, basics and techniques
p 251 A92-45030
- A progress report on ASTOVL control concept studies under the VAAC programme
p 104 A92-45319
- ATTAS flight test and simulation results of the advanced gust management system LARS
[AIAA PAPER 92-4343]
p 106 A92-55332
- Numerical simulations around models in hypersonic wind tunnels
p 36 N92-14998
- Evaluation of the COMPAS experimental system
p 63 N92-19044
- ATTAS experimental cockpit and ATMOS for flight control components and systems investigations
p 65 N92-25595
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- Opportunities for flight simulation to improve operational effectiveness
p 115 N92-28523
- Flight simulation and digital flight controls
p 115 N92-28526
- Validation of simulation systems for aircraft acceptance testing
p 86 N92-28531
- Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532
- G-tolerance and spatial disorientation: Can simulation help us?
p 248 N92-28534
- AM-X flight simulator from engineering tool to training device
p 116 N92-28536
- The role of simulation for the study of APIS (piloting support by synthetic imagery)
p 116 N92-28544
- Initial validation of a R/D simulator with large amplitude motion
p 116 N92-28546
- Effective cueing during approach and touchdown: Comparison with flight
p 117 N92-28552
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft
p 87 N92-29616
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315]
p 118 N92-30769
- Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management
[AGARD-AR-310]
p 264 N92-32229
- Development of new flight procedures for the Microwave Landing System (MLS)
[NLR-TP-91156-U]
p 66 N92-32830
- FLIGHT SIMULATORS**
- Flying the A340 iron bird
p 67 A92-10666
- Utilization of a research simulator for the development of new flight control concepts
[ONERA, TP NO. 1991-161]
p 110 A92-16128
- Real-time helicopter simulation using the blade element method
p 264 A92-56278
- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3
p 84 N92-25591
- The basic measuring technical equipment of the DLR test aircraft
p 92 N92-25592
- Opportunities for flight simulation to improve operational effectiveness
p 115 N92-28523
- Flight simulation and digital flight controls
p 115 N92-28526
- AM-X flight simulator from engineering tool to training device
p 116 N92-28536
- The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations
p 116 N92-28539
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool
p 116 N92-28541
- Use of a research simulator for the development of new concepts of flight control
p 116 N92-28543
- Initial validation of a R/D simulator with large amplitude motion
p 116 N92-28546
- Effective cueing during approach and touchdown: Comparison with flight
p 117 N92-28552
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315]
p 118 N92-30769
- FLIGHT SURGEONS**
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine
[AGARD-AG-324]
p 244 N92-13547
- The pilot flight surgeon bond
p 250 N92-13548
- Aviation psychology in the operational setting
p 250 N92-13550
- FLIGHT TEST INSTRUMENTS**
- Flight test of avionic and air-traffic control systems [ETN-92-91063]
p 65 N92-25590
- The basic measuring technical equipment of the DLR test aircraft
p 92 N92-25592
- Introduction and execution of flight tests at the DLR
p 85 N92-25594
- Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES
p 65 N92-25600
- Potential applications of laser Doppler anemometry for in-flight measurements
[NLR-TP-90163-U]
p 92 N92-28654
- FLIGHT TEST VEHICLES**
- Flight test of avionic and air-traffic control systems [ETN-92-91063]
p 65 N92-25590
- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3
p 84 N92-25591
- The basic measuring technical equipment of the DLR test aircraft
p 92 N92-25592
- The role of systems simulation for the development and qualification of ATTAS
p 117 N92-28548
- FLIGHT TESTS**
- Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor
p 67 A92-14398
- JAS 39 Gripen progress report
p 67 A92-16058
- Tilting at targets --- tilt rotor aircraft development
p 68 A92-25074
- Aircraft lightning strikes
[ONERA, TP NO. 1991-204]
p 54 A92-26361
- Sentinel 1000 flight test programme overview and preliminary results
[AIAA PAPER 92-1229]
p 69 A92-33326
- First results from the Netherlands SAR testbed 'PHARS'
--- Phased array universal SAR
p 221 A92-34903
- Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme
p 70 A92-35767
- Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program
p 60 A92-35928
- Fokker 50 flameouts in icing conditions
p 71 A92-35940
- Concorde flight testing - Powerplant and performance flying
[SAE PAPER 912192]
p 72 A92-40009
- JAS 39 Gripen flight test report
p 72 A92-40030
- A computerized flight inspection system --- for testing of basic air navigation ground facilities
p 61 A92-43881
- Regional challenge --- flight test of Canadair Regional Jet
p 74 A92-53121
- Some important factors in turbulence in flight measurement
p 90 A92-54324
- ATTAS flight test and simulation results of the advanced gust management system LARS
[AIAA PAPER 92-4343]
p 106 A92-55332
- Short takeoff optimization for the XV-15 tiltrotor aircraft
p 74 A92-56302
- The achievement of aerodynamic goals on the EH101 project through the 'single site' concept
p 75 A92-56342
- Correlation of flight, tunnel and prediction data on a helicopter main rotor
p 75 A92-56350
- Rotorcraft system identification
[AGARD-AR-280]
p 75 N92-11001
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics
p 37 N92-15017
- Model parameter identification techniques for flight flutter testing
[AERO-REPT-9105]
p 107 N92-18294
- Manoeuvring Aerodynamics
[AGARD-CP-497]
p 80 N92-18778
- X-31: Discussion of steady state and rotary derivatives
p 81 N92-18789
- Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data
p 81 N92-18790
- EH 101 ship interface trials: Flight test programme and preliminary results
p 82 N92-21964
- United Kingdom approach to deriving military ship helicopter operating limits
p 82 N92-21966
- Flight test of avionic and air-traffic control systems [ETN-92-91063]
p 65 N92-25590
- Introduction and execution of flight tests at the DLR
p 85 N92-25594
- Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES
p 65 N92-25600
- Testing of an experimental photographic reconnaissance system
p 209 N92-25602
- Separation of external stores: Comparison of results [F+W-TF-2056]
p 85 N92-26944
- Aircraft ship operations
[AGARD-AR-312]
p 85 N92-28468
- Validation of simulation systems for aircraft acceptance testing
p 86 N92-28531
- Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092]
p 270 N92-32956
- Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data
p 270 N92-32960
- LARVE: A hypersonic flight test facility launched by Ariane 4
[PB92-138726]
p 118 N92-70983
- FLIGHT TIME**
- Time-to-go estimation from infrared images
p 61 A92-48308
- FLIGHT TRAINING**
- Opportunities for flight simulation to improve operational effectiveness
p 115 N92-28523
- Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315]
p 118 N92-30769
- FLIR DETECTORS**
- Infra-red offers new landing aid competition
p 88 A92-18937
- Fixed wing night attack EO integration and sensor fusion
p 253 N92-19009
- Passive optical and IR sensors
[MBB-UH-HE512]
p 224 N92-23392
- Airborne experimental FLIR program
p 93 N92-32447
- FLOATING**
- Effect of viscous damping on the response of floating bodies
p 187 N92-14303
- FLOW CHAMBERS**
- Automation of the measurement process in the N2 wind tunnel with the SPITA N-3 system
p 110 A92-12522
- FLOW CHARACTERISTICS**
- Insight into singular vortex flows
p 183 A92-53052
- Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55]
p 187 N92-12216
- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution
[ESDU-91029]
p 39 N92-15973
- Manoeuvring Aerodynamics
[AGARD-CP-497]
p 80 N92-18778
- Problem 3: Flow over a 2-D ramp Navier-Stokes calculations
p 42 N92-22180
- Separation of relaminarised boundary layers
[CUED/A-AERO/TR-16]
p 195 N92-22209
- Boundary Layers in Turbomachines
[VKI-LS-1991-06]
p 99 N92-24336
- Upper/lower vortex interaction and potential vorticity inversion
p 233 N92-26331
- FLOW COEFFICIENTS**
- Total losses in turbulent flows inside conical diffusers
p 23 A92-47782
- FLOW DISTORTION**
- Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction
p 12 A92-24426
- Inlet distortion effects in aircraft propulsion system integration
p 102 N92-28464
- Experimental examination of heavily loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489]
p 202 N92-29926
- FLOW DISTRIBUTION**
- Topology of steady flows of low viscosity fluids
p 162 A92-11219
- Design and performance of advanced blading for a high-speed HP compressor
[ASME PAPER 91-GT-374]
p 9 A92-15718
- Asymptotic techniques for the analysis of fluid systems
p 163 A92-16229
- Incompressible steady aerodynamics using a standard finite element code
p 11 A92-20218
- Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil
[AIAA PAPER 92-0027]
p 11 A92-22149
- Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena
p 12 A92-24428
- The evaluation of canard couplings at high angles of attack
[AIAA PAPER 92-0281]
p 12 A92-25735
- Determination of the aerodynamic flow about a reentry body at high altitude
p 14 A92-28975
- Simulation of hypersonic flows on unstructured grids
p 15 A92-31496
- Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil
p 16 A92-38858
- Second moment closure predictions of jet-on-jet impingement flows
p 173 A92-40102
- Flow structure and mixing in obstructed and confined jets
p 174 A92-40107
- Influence of suction through a slot on a turbulent boundary layer
p 18 A92-40127

A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300
 Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
 The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
 The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
 Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604
 Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
 Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164
 Jet noise classical theory and experiments p 268 N92-10602
 Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 N92-12203
 Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
 Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 N92-12219
 Aeroacoustics in inhomogeneous flow field [FFA-TN-1991-30] p 268 N92-12601
 Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001
 On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
 Vortex flow on a missile body: Experimental study and modeling p 32 N92-13013
 Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
 The turbomachine blading design using S2-S1 approach p 97 N92-13940
 Research on inverse methods and optimization in Italy p 97 N92-13956
 LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 N92-14004
 Effect of viscous damping on the response of floating bodies p 187 N92-14303
 Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
 Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
 Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
 Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 N92-14992
 Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994
 Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 N92-14995
 Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
 Numerical simulations around models in hypersonic wind tunnels p 36 N92-14998
 SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999
 High enthalpy nozzle flows p 36 N92-15000
 Short time force measurement system p 114 N92-15001
 Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 N92-15002
 Verification and application of the NSFLEX method for hypersonic flow conditions p 36 N92-15005
 Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
 Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 N92-15025
 Visualization of instantaneous flows by particle traces p 189 N92-16234
 Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231
 Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232
 The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 N92-18291
 Towards the computation of turbulent hypersonic flows [AERO-REPT-9106] p 40 N92-18318

On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319
 Numerical solutions for uniform flow around symmetrical bodies using panel methods [AERO-REPT-9014] p 192 N92-18320
 VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323
 A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 N92-19294
 Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 N92-19296
 Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 N92-19916
 A linearized Riemann solver for Godunov-type methods [CRANFIELD-AERO-9116] p 265 N92-19924
 Hypersonic wakes [ETN-92-91082] p 41 N92-19925
 Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317
 MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468
 Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703
 Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 N92-21704
 Practical application of 3-D CFD methods to gas turbine combustors [PNR-90773] p 194 N92-21742
 Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955
 Applications of boundary integral methods to the study of steep free surface waves p 195 N92-23149
 On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
 Computation and visualization of specific flow phenomena in turbomachinery application p 100 N92-27463
 An integrated CFD system for 3D turbomachinery applications p 101 N92-27464
 Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469
 The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482
 Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483
 Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
 Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
 Comparison of LDA and LTA applications for propeller tests in wind tunnels [NLR-MP-88031-U] p 47 N92-28658
 The 2D-computation of an axial fan with FINFLO [PB92-180678] p 203 N92-30023
 MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document [FFA-TN-1990-20] p 50 N92-30713
 New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 N92-32730
 An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 N92-32732
 Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 N92-32734
 Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames [ETN-92-92103] p 205 N92-33916
 Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166
 Selection of a laser anemometer technique for propeller tests in wind tunnels [PB92-138510] p 118 N92-70563
 System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
 Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow [PB92-138718] p 53 N92-70577

FLOW EQUATIONS

The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
 Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
 On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory p 184 A92-55479
 Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
 Fast finite element solvers for reentry flows p 35 N92-14988
 Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989
 Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
 A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
 The laminar natural convection on a horizontal surface [AERO-REPT-9015] p 191 N92-18236
 On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319
 Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
 Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
 Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
FLOW GEOMETRY
 Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
 Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703
 Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes [ONERA, TP NO. 1991-237] p 13 A92-26387
 Cell vertex finite volume discretizations in three dimensions p 168 A92-27475
 Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
 Transition to turbulence in curved channel flow p 18 A92-40125
 Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
 A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
 Helicity in laminar and turbulent flow p 177 A92-45089
 Experimental investigation of vortex dynamics on delta wings [AIAA PAPER 92-2731] p 21 A92-45565
 Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 N92-19932
 Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
 Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
 Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476
FLOW MEASUREMENT
 Automation of the measurement process in the N2 wind tunnel with the SPITA N-3 system p 110 A92-12347
 Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines [ONERA, TP NO. 1991-170] p 110 A92-16135
 Hot-wire measurements in turbulent transonic flows p 26 A92-53078
 Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique p 26 A92-54308
 The SR3 low density wind tunnel - Facility capabilities and research development [AIAA PAPER 92-3972] p 112 A92-56798
 Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 N92-11288
 Radial inflow turbine study [AD-A246938] p 101 N92-28073
 Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TR-88072-U] p 49 N92-29884
 Radial inflow turbine study [AD-A252783] p 214 N92-33538

Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades
[ETN-92-92056] p 205 N92-33910

FLOW REGULATORS
Internal flow modelling of vortex throttles
p 168 A92-27385

FLOW STABILITY
On the Arnold stability criterion for steady-state flows of an ideal fluid p 165 A92-21506
Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
The nonlinear stability of flows over compliant walls p 179 A92-46265
Some problems of the stability of a system of three vortices p 182 A92-51893
Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963
Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 A92-13022
Formation and stability of a semi-infinite vorticity line under an adherence condition p 193 A92-20230
[ETN-92-91075]
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 A92-21237
The stability of barotropic vortices: Implications for tropical cyclone motion p 240 A92-26335
Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942

FLOW THEORY
Boundary layer flow in axial compressors (theoretical part) p 194 A92-21232
[ETN-92-91006]
Boundary layer flow in axial compressors (theoretical part) p 194 A92-21234
[ETN-92-91008]

FLOW VELOCITY
Aerosol behavior in supersonic flows [ONERA, TP NO. 1991-155] p 206 A92-16124
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
Model and computation of discrete jets in crossflow p 165 A92-21505
Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation [ONERA, TP NO. 1991-235] p 168 A92-26386
Impinging jets in cross-flow p 169 A92-28942
Velocity correlation in isotropic turbulence according to a modified Obukhov theory p 169 A92-28950
Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
Instantaneous visualization of surface flows p 207 A92-44327
Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 A92-20317
The COPPEF-model for solid fuel combustion chamber performance prediction p 142 A92-22270
Fuel pyrolysis in solid fuel combustion chambers p 142 A92-22271
A subgrid-scale model based on the second-order velocity structure function p 203 A92-30651

FLOW VISUALIZATION
Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675
Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483
CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185
Marangoni convection in V-shaped containers p 172 A92-37932

Flow structure and mixing in obstructed and confined jets p 174 A92-40107
Instantaneous visualization of surface flows p 207 A92-44327
Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079
Characterization of subcritical and supercritical jets by an acoustic imagery method [ONERA, TP NO. 1992-34] p 267 A92-48595
The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 A92-11308
Nonstationary flight aerodynamics in a turbulent environment [ETN-91-90102] p 29 A92-11980
Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 A92-13010
An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 A92-13015
Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
Computer Graphics and Flow Visualization in Computational Fluid Dynamics [VKI-LS-1991-07] p 189 A92-16226
Three-dimensional computer graphics in flow visualization p 189 A92-16227
The recovering of flow features from large numerical data bases p 189 A92-16231
Visualization of instationary flows by particle traces p 189 A92-16234
Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 A92-18786
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 A92-21703
Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 A92-22179
Boundary layer transition on concave surfaces p 195 A92-22200
Computation and visualization of specific flow phenomena in turbomachinery application p 100 A92-27463
An integrated CFD system for 3D turbomachinery applications p 101 A92-27464
Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 A92-27671
An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 A92-32732
Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 A92-32800

FLOWMETERS
Instantaneous visualization of surface flows p 207 A92-44327

FLUENCE
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 A92-27300

FLUID BOUNDARIES
Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
Extrapolation procedures for the time-dependent Navier-Stokes equations p 19 A92-41289

FLUID DYNAMICS
The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum p 15 A92-32323
Asymmetric vortex flow over circular cones p 32 A92-13014
Panel methods for aerodynamic analysis and design p 84 A92-23955
Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 A92-27706
Continuous wavelet analysis of coherent structures p 203 A92-30673

FLUID FILLED SHELLS
Spin-up in a semicircular cylinder p 184 A92-56123

FLUID FLOW
Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
Mikado: A graphic program p 190 A92-16237

Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment p 56 A92-21697
Computation and visualization of specific flow phenomena in turbomachinery application p 100 A92-27463
Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 A92-30453
Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 A92-32725
Exotic states in the cores of quantized vortices for superfluids and superconductors [DE92-728466] p 206 A92-70151

FLUID MECHANICS
Numerical fluid mechanics - Incompressible flows with complex boundaries --- Book [ISBN 3-540-53137-8] p 169 A92-29649
Base bleed technology in perspective p 17 A92-39427
Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 176 A92-42529
Wavelet transforms and their applications to turbulence p 177 A92-45091
Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 A92-18244
Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 A92-34152

FLUID-SOLID INTERACTIONS
Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704
The interaction between a high-frequency gust and a blade row p 267 A92-54484
The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449
Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 A92-23844
A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 A92-23846
The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 A92-33033

FLUIDICS
Internal flow modelling of vortex throttles p 168 A92-27385

FLUTTER
Model parameter identification techniques for flight flutter testing [AERO-REPT-9105] p 107 A92-18294
Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 A92-27936
Computation of flutter boundaries in the time and frequency domain p 46 A92-27952
Direct coupling of fluid structure in transonic aeroelasticity p 46 A92-27954
Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 A92-34161
Flutter models: Their design, manufacture, and ground testing p 109 A92-34164

FLUTTER ANALYSIS
Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625
Model parameter identification techniques for flight flutter testing [AERO-REPT-9105] p 107 A92-18294
Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 A92-20475
Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 A92-23238
Transonic aeroelastic calculations in both the time and frequency domains p 46 A92-27950
NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 A92-32750
Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 A92-34161
Flutter models: Their design, manufacture, and ground testing p 109 A92-34164
Unsteady wind tunnel tests p 109 A92-34166

FLUX PINNING

Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors p 273 N92-21635

FLUX VECTOR SPLITTING

Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617
The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
Influence of chemical modelling on hypersonic flow p 37 N92-15015
Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 A92-21704
Multidimensional upwind methods for unstructured grids p 201 N92-27675

FLY BY WIRE CONTROL

Delivered with feeling --- computer-based design of flight control system for Boeing 777 p 103 A92-16621
A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616

FLYING PERSONNEL

Aviation psychology in the operational setting p 250 N92-13550

FOG

Trial of a slant visual range measuring device p 210 N92-31043
Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106

FOKKER AIRCRAFT

Tax aspects of aircraft leasing in the Netherlands p 280 A92-35588
Fokker 50 flameouts in icing conditions p 71 A92-35940
The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694
The 3-D Euler flows around modern airplanes [PB92-138759] p 52 N92-70540

FOOD PROCESSING

Critical technologies: Spacecraft habitability, an update p 254 N92-27010

FOOTPRINTS

On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

FORCE DISTRIBUTION

Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds [ESDU-91042] p 84 N92-24009
Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946

FOREBODIES

Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 N92-11967
Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022
Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793

FOREST MANAGEMENT

The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing p 223 A92-44167

FORESTS

Sodar wind speed profiles over forested boundary layer during the Hapex-Mobility campaign p 235 A92-17729
The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691

FORM FACTORS

SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249

FORMING TECHNIQUES

Cost effective solutions for titanium sheet metal forming p 211 A92-22785

Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742

FOURIER ANALYSIS

Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460

FRACTALS

Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200

FRACTOGRAPHY

Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950

FRACTURE MECHANICS

High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 N92-14397
A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795
Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 N92-28643

FRACTURE STRENGTH

Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
An integrated approach to developing tough epoxies p 145 A92-51563
Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 N92-28850

FRANCE

Recent progress in inverse methods in France p 97 N92-13938

FREE CONVECTION

Asymmetric oscillations in thermosolutal convection p 164 A92-19964
Convection-induced shears for general planforms p 177 A92-44352
Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166

FREE FLIGHT

Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704
Hang-glider response to atmospheric inputs p 104 A92-46765
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017

FREE FLOW

Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet p 183 A92-52794
An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
Blade design and analysis using a modified Euler solver p 97 N92-13952
A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 N92-24343
Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946

FREE MOLECULAR FLOW

Drag coefficients with applications to satellite orbits p 133 N92-11069
Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032

FREEZING

Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455

FRENCH SATELLITES

The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850

FRENCH SPACE PROGRAM

French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683
The French space programme p 121 A92-53458
France and the Peenemuende legacy [IAF PAPER 92-0186] p 286 A92-55641

The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850

FREQUENCIES

Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507

FREQUENCY ASSIGNMENT

The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852

FREQUENCY RANGES

The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852

FREQUENCY STANDARDS

Do we really need 57 ways of rating aircraft noise? p 227 A92-39065

FRESH WATER

Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453

FRICTION

Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507

FRICTION REDUCTION

Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 N92-27706
Basic concepts on boundary layers p 44 N92-27707

FRONTS (METEOROLOGY)

The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329

FROST

The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692

FROZEN EQUILIBRIUM FLOW

Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479

FUEL COMBUSTION

Gravitational effects on flame spreading over thin cylindrical fuel samples p 147 A92-14020

FUEL CONSUMPTION

Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter [FFA-TN-1991-22] p 76 N92-11993
Drag reduction: An industrial challenge p 44 N92-27708
Practical considerations in designing the engine cycle p 102 N92-28460

FUEL CONTROL

The numerical simulation of the main fuel control unit of gas turbine engines [AIAA PAPER 92-3760] p 96 A92-49115

FUEL FLOW

The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271
Spin-offs of the solid fuel combustion chamber project p 143 N92-22275

FUEL INJECTION

Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317

FUEL SPRAYS

Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297

FUEL TANKS

On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
Separation of external stores: Comparison of results [F+W-TF-2058] p 85 N92-26944

FULL SCALE TESTS

Mean wind speeds over hills and other topography [ESDU-91043] p 240 N92-17853

FUNCTIONAL DESIGN SPECIFICATIONS

Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 N92-29615
A multivariable control concept for a gas turbine engine [ETN-92-92104] p 102 N92-33645

FUSELAGES

Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356

- Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086
- Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087
- Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
- Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
- Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 A92-14045
- Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 A92-17310
- Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 A92-18333
- Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 A92-18579
- Ageing airplane repair assessment program for Airbus A300 p 57 A92-30123
- CFRP stiffened panels under compression p 146 A92-33044
- FUZZY SYSTEMS**
- Fuzzy guidance system evaluation p 259 A92-27903

G

- G-222 AIRCRAFT**
- The G-222 aircraft individual tracking programme p 78 A92-18582
- GALACTIC COSMIC RAYS**
- The sun, the solar wind, and cosmic rays p 285 A92-27131
- GALERKIN METHOD**
- A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256
- A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
- Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
- Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
- Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 A92-24963
- Finite element methods for flow problems p 200 A92-27672
- GALILEO SPACECRAFT**
- Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208
- GAME THEORY**
- Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
- Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 A92-12156
- GAMMA RAY ASTRONOMY**
- The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma p 140 A92-10563
- GAMMA RAY BURSTS**
- The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 A92-27049
- GAS BEARINGS**
- Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 A92-25875
- GAS DENSITY**
- Oxygen isotopes implanted in the LDEF spacecraft p 272 A92-27284
- GAS DYNAMICS**
- Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 161 A92-10654
- Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
- Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 A92-14978
- Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 A92-15033

- Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 A92-19916
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 A92-32767
- GAS EXPANSION**
- Near-field expansion in thruster plumes p 141 A92-52799
- GAS FLOW**
- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261
- Rarefied gas dynamics; Proceedings of the 17th International Symposium, Rheinisch-Westfälische Technische Hochschule Aachen, Germany, July 8-14, 1990 [ISBN 1-56081-122-6] p 274 A92-52701
- Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
- Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770
- Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
- Entropy production in gaseous boundary layers p 183 A92-52814
- Cell vertex methods for compressible gas flows p 197 A92-26599
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 A92-32767
- GAS INJECTION**
- Base bleed technology in perspective p 17 A92-39427
- Computer codes for ballistic performance calculations of base bleed propellant grain p 17 A92-39433
- GAS JETS**
- Flow structure and mixing in obstructed and confined jets p 174 A92-40107
- Spacecraft attitude control using magnetic torquers and gas jets p 137 A92-24496
- GAS MIXTURES**
- Recent progress in reactive flow computations p 167 A92-26220
- Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739
- Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 A92-10988
- Linear acoustics in gas mixtures with rate processes p 269 A92-15013
- GAS TRANSPORT**
- Flow structure and mixing in obstructed and confined jets p 174 A92-40107
- GAS TURBINE ENGINES**
- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
- Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667
- A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines [ASME PAPER 91-GT-392] p 162 A92-15722
- Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
- CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376
- The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
- Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
- Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
- Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172
- Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548
- The use of optical sensors and signal processing gas turbine engines p 90 A92-46247
- Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791
- Expert systems for the trouble-shooting and the diagnostics of engines [AIAA PAPER 92-3327] p 260 A92-48910

- Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- The numerical simulation of the main fuel control unit of gas turbine engines [AIAA PAPER 92-3760] p 96 A92-49115
- Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
- CIS engines - The range revealed. II p 96 A92-54546
- Parallel processing applications for gas turbine engine control p 96 A92-11012
- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 A92-12203
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 A92-12206
- Software methodologies for safety critical systems p 257 A92-12467
- The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 A92-20574
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 A92-21740
- Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 A92-22406
- Steady and Transient Performance Prediction of Gas Turbine Engines [AGARD-LS-183] p 101 A92-28458
- Practical considerations in designing the engine cycle p 102 A92-28460
- Steady and transient performance calculation method for prediction, analysis, and identification p 102 A92-28461
- Calculation of installation effects within performance computer programs p 102 A92-28465
- A multivariable control concept for a gas turbine engine [ETN-92-92104] p 102 A92-33645
- GAS TURBINES**
- Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
- The design and testing of a radial flow turbine for aerodynamic research [ASME PAPER 91-GT-220] p 93 A92-15636
- Radial inflow turbine study [AD-A240169] p 96 A92-11015
- Recent progress in inverse methods in France p 97 A92-13938
- Practical application of 3-D CFD methods to gas turbine combustors [PNR-90773] p 194 A92-21742
- The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 A92-27062
- Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 A92-27484
- Radial inflow turbine study [AD-A246938] p 101 A92-28073
- Radial inflow turbine study [AD-A252783] p 214 A92-33538
- GAS-SOLID INTERACTIONS**
- Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients p 123 A92-15818
- Fluid dynamic forces on tethered satellite systems p 124 A92-52738
- Drag coefficients with applications to satellite orbits p 133 A92-11069
- GEARS**
- Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815
- GEOGRAPHIC INFORMATION SYSTEMS**
- A SAR processor for a GIS environment p 155 A92-34980
- GEOIDS**
- Selected models of aircraft navigation space p 61 A92-45373
- GEOMAGNETISM**
- Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 A92-23975
- GEOMETRIC ACCURACY**
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 A92-29707

GEOPHYSICAL OBSERVATORIES

- The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
 Antarctic studies of the cusp p 233 N92-26301
 The need of coordinated observations in space and from ground p 233 N92-26310

GEOSAT SATELLITES

- Detection of mesoscale ocean currents from Gepsat altimeter data p 242 A92-34949

GEOSTROPHIC WIND

- The enigmatic merging conditions of two-layer baroclinic vortices p 162 A92-11225
 A theoretical test of the geostrophic momentum approximation p 237 A92-39471
 Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge [AD-A241072] p 232 N92-13512

GEOSYNCHRONOUS ORBITS

- Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
 Photographic observations of the co-located spacecraft at 19 deg West p 138 N92-24724
 Limitation of space debris in geostationary transfer orbit p 125 N92-24774

GERMAN SPACE PROGRAM

- The German Hypersonics Technology Programme - Status report 1992 [IAF PAPER 92-0867] p 127 A92-57258
 DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
 List of reports, 1989 p 278 N92-71169
 List of reports, 1990 p 278 N92-71170

GERMANY

- Air transport research in Germany p 1 A92-21014
 German-GUS cooperation in civil aviation p 3 A92-47592
 The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
 DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
 The DLR meteorological research aircraft Falcon p 240 N92-26348
 DLR research reports and communications [ETN-92-91391] p 287 N92-29218
 Activities report of the DLR [ETN-92-91392] p 287 N92-29219
 MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686

GLACIERS

- Interpretation of field measurements made with a portable albedometer p 207 A92-49773

GLASS FIBERS

- Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966

GLIDERS

- Review of aerodynamic design in the Netherlands p 76 N92-13929

GLOBAL ATMOSPHERIC RESEARCH PROGRAM

- Planetary vision as a strategy p 229 N92-25243

GLOBAL POSITIONING SYSTEM

- Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
 Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
 Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928
 GPS/GLONASS user systems in Sweden p 61 A92-38384
 Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
 GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 N92-24443

GLOBAL WARMING

- Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193

GOERTLER INSTABILITY

- The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
 Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
 On the development of Goertler vortices in wall jet flow p 177 A92-44501
 The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441

- Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
 Boundary layers and transition on concave surfaces p 196 N92-24341

GOGGLES

- Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008
 Fixed wing night attack EO integration and sensor fusion p 253 N92-19009

GOVERNMENT PROCUREMENT

- The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 N92-14046

GOVERNMENT/INDUSTRY RELATIONS

- Sweden and the space plane - A small country with high ambition [AIAA PAPER 91-5005] p 119 A92-17804
 Australian space - Looking for a direction p 120 A92-36073
 Sunrise aerospace --- technology development in the Pacific Rim p 3 A92-46448

GRANULAR MATERIALS

- Computer codes for ballistic performance calculations of base bleed propellant grain p 17 A92-39433

GRAPHITE

- The stability of graphite brushes at high velocity [ETN-91-90176] p 160 N92-12184
 Application of eddy current techniques to graphite composite materials [ETN-92-90815] p 145 N92-21416

GRAPHITE-EPOXY COMPOSITES

- Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 N92-14397

GRASSLANDS

- Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
 Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

GRAVITATIONAL EFFECTS

- Gravitational effects on flame spreading over thin cylindrical fuel samples p 147 A92-14020
 Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
 Changes observed in lymphocyte behavior during gravitational unloading p 247 A92-52395
 Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978

GRAVITATIONAL FIELDS

- Gravity field data products from the Aristoteles mission p 224 N92-23925

GRAVITATIONAL PHYSIOLOGY

- Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547
 Gravity effects on reproduction, development, and aging p 244 A92-34193
 Blood lactate during leg exercise in microgravity p 247 A92-50162
 Changes observed in lymphocyte behavior during gravitational unloading p 247 A92-52395
 Rib cage shape and motion in microgravity p 247 A92-56944
 Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
 G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
 Control of blood pressure in humans under microgravity p 248 N92-23071

GRAVITY GRADIENT SATELLITES

- LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468
 A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527

GRAVITY GRADIOMETERS

- Gravity field data products from the Aristoteles mission p 224 N92-23925

GREEN'S FUNCTIONS

- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336
 Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507

GRID GENERATION (MATHEMATICS)

- IGG - An interactive 3D surface modelling and grid generation system [AIAA PAPER 92-0073] p 256 A92-22186
 Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034

- Cell vertex finite volume discretizations in three dimensions p 168 A92-27475
 Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics [ONERA, TP NO. 1992-30] p 171 A92-31488

- A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
 The computation of three-dimensional flows using unstructured grids p 16 A92-37539
 Panel method control in 3-D hyperbolic grid generation p 17 A92-39940

- A new automatic grid generation environment for CFD applications [AIAA PAPER 92-2720] p 21 A92-45558

- An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
 An unstructured mesh generation algorithm for three-dimensional aeronautical configurations p 262 A92-47053
 3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
 Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
 Patch-independent structured multiblock grids for CFD computations p 263 A92-47078

- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079
 Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
 Multigrid grid generation in scalar and parallel environments p 256 A92-47084
 The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
 Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090
 Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 N92-10988

- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 N92-14990
 Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030
 Grid impact on 3D hypersonic flows p 39 N92-15041
 Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312
 MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468
 Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234

- Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 N92-24411
 TRANSF3: A 3-D grid generator based on transfinite interpolation [PB92-151919] p 259 N92-25519

- An integrated CFD system for 3D turbomachinery applications p 101 N92-27464
 Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476
 Unstructured grid methods for compressible flows p 201 N92-27676
 Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 N92-27678
 A frontal approach for node generation in Delaunay triangulations p 201 N92-27680
 Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
 Hyperbolic grid generation with BEM source terms [NLR-TP-90334-U] p 264 N92-28635
 Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 N92-29604
 MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document [FFA-TN-1990-20] p 50 N92-30713

- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 N92-32730
 Finite element simulation of viscoelastic flow p 205 N92-34038

- GROUND BASED CONTROL
 Computation of aircraft geometric height under radar surveillance p 61 A92-40239

SUBJECT INDEX

- Launch Bases and Control Infrastructures for Spacecraft**
[ESA-SP-342] p 125 N92-20715
- GROUND CREWS**
Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- GROUND EFFECT (AERODYNAMICS)**
Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549
Recent developments at the Shoeburyness STOL test facility p 111 A92-45314
Hot-gas reingestion - Engine response considerations p 95 A92-45317
The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
Recent developments at the Shoeburyness (England) STOL Test Facility [PNR-90806] p 115 N92-22096
- GROUND HANDLING**
Testing concept of a movement area guidance p 65 N92-25597
- GROUND STATE**
Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 N92-21788
- GROUND STATIONS**
The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
The need of coordinated observations in space and from ground p 233 N92-26310
- GROUND SUPPORT EQUIPMENT**
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
Introduction and execution of flight tests at the DLR p 85 N92-25594
- GROUND SUPPORT SYSTEMS**
A computerized flight inspection system --- for testing of basic air navigation ground facilities p 61 A92-43881
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
Esrance: Sounding rocket and balloon facility p 126 N92-20720
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
The USOCs, the resources management, and their links with telepresence p 276 N92-33466
- GROUND TESTS**
Aircraft ground vibration test by means of flight control surfaces [ONERA, TP NO. 1991-96] p 103 A92-16079
Advances in aircraft modal identification [ONERA, TP NO. 1992-47] p 105 A92-48608
Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189
Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- GROUND WATER**
Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372
- GROUND-AIR-GROUND COMMUNICATION**
The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system p 58 A92-13851
The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852
A European perspective on the co-operative air traffic management concept p 60 A92-33427
Inmarsat aeronautical mobile satellite system: Internetworking issues p 158 N92-24098
- GROUP THEORY**
Wavelet transforms and their applications to turbulence p 177 A92-45091
- GUIDANCE (MOTION)**
Optimal guidance anticipating missile performance p 128 N92-27902
- GUIDE VANES**
Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 N92-14319

Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466

GUNFIRE

Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction p 12 A92-24426

GUNS (ORDNANCE)

The other missiles p 2 A92-28184

GUST LOADS

International standardisation of regulations for gust loading calculations p 68 A92-22473
Gust effects on a flexible aircraft p 68 A92-22474
The interaction between a high-frequency gust and a blade row p 267 A92-54484
ATTAS flight test and simulation results of the advanced gust management system LARS [AIAA PAPER 92-4343] p 106 A92-55332
Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
Short cracks and durability analysis of the Fokker 100 wing/fuselage structure [NLR-TP-90336-U] p 220 N92-29603
Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989 [PB92-138650] p 88 N92-70591

GUSTS

Thermographic gust wind tunnel measurements [ONERA-RF-31/3409-PY] p 29 N92-11972

H

HABITABILITY

Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007
Critical technologies: Spacecraft habitability, an update p 254 N92-27010
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
Moon base habitability aspects p 254 N92-27026

HAISTORMS

Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342

HAMILTONIAN FUNCTIONS

A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866
Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728

HANG GLIDERS

Hang-glider response to atmospheric inputs p 104 A92-46765

HARDWARE

Test and integration concept for complex helicopter avionic systems p 90 A92-56292

HARMONIC CONTROL

BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344

HARMONIC EXCITATION

Computation of flutter boundaries in the time and frequency domain p 46 N92-27952

HARMONIC OSCILLATION

Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 N92-18786
Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

HARMONICS

Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

HARRIER AIRCRAFT

VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306
ASTCWL engine control p 95 A92-45321
VSTOL engine design evolution: Growth of the Pegasus engine for Harrier [PNR-90805] p 99 N92-27039

HAWK MISSILE

Four decades of transonic fighter design p 68 A92-20203

HAZARDS

Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 N92-32961

HEAD DOWN TILT

Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547

HEAT TRANSFER COEFFICIENTS

Control of blood pressure in humans under microgravity p 248 N92-23071

HEAD-UP DISPLAYS

Infra-red offers new landing aid competition p 88 A92-18937

Knowledge transfer and support systems in fighter aircraft p 251 A92-45047

HEADACHE

Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703

HEART RATE

Heart rate variability as an index for pilot workload p 246 A92-45012
Circulatory biomechanics effects of accelerations p 248 N92-18991

HEAT BUDGET

The stratospheric residual circulation as deduced from satellite data p 232 N92-14498

HEAT EXCHANGERS

The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666
The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986

HEAT FLUX

The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
Thermal control of spacecraft p 132 A92-33413
On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 N92-27148

HEAT PIPES

Two-phase thermal technology for space application: Development status p 138 N92-25834
Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 N92-26974

HEAT PUMPS

Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120

HEAT RADIATORS

Two-phase thermal technology for space application: Development status p 138 N92-25834

HEAT RESISTANT ALLOYS

High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
MA alloys for aerospace applications --- Mechanical Alloying p 149 A92-26128
Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
The search for new materials [PNR-90777] p 145 N92-21744

HEAT SHIELDING

Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

HEAT TRANSFER

Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506
Recent progress in inverse methods in France p 97 N92-13938
Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 N92-14991
The dynamic response of separated hypersonic flows p 38 N92-15019
Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
Practical considerations in designing the engine cycle p 102 N92-28460
Flat plates placed in depleted hypersonic flow [SESSIA-430/91.960] p 50 N92-31508

HEAT TRANSFER COEFFICIENTS

Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126
Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450

Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430

HEAT TREATMENT

A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 N92-20911

HEATING

Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120

HEAVY LIFT LAUNCH VEHICLES

The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510

HELICAL FLOW

Helicity in laminar and turbulent flow p 177 A92-45089

HELICOPTER CONTROL

The use of inverse simulation for conceptual design p 70 A92-35738
Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
Trimming rotor blades with periodically deflecting trailing edge flaps p 106 A92-56283
Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
Rotorcraft system identification [AGARD-AR-280] p 75 N92-11001
Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 N92-12004
Double loop control law strategy and applications to helicopter [CERT-2/7724-DEFA] p 108 N92-19295
EH 101 ship interface trials: Flight test programme and preliminary results p 82 N92-21964

HELICOPTER DESIGN

Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
P120 programme - First results of the pre-development phase p 1 A92-14447
Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations [ONERA, TP NO. 1991-187] p 10 A92-16141
Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356
The development of a new light, single engine helicopter family p 70 A92-35734
EUROFAR airframe aerodynamic design p 70 A92-35750
Progress towards quieter civil helicopters p 267 A92-52847
Repair procedures for advanced composites for helicopters p 4 A92-56277
Test and integration concept for complex helicopter avionic systems p 90 A92-56292
Organization and technical status of the NH90 European helicopter programme p 4 A92-56306
Lynx - A 50 year product? p 75 A92-56307
Current European research activities in helicopter interaction aerodynamics p 75 A92-56330
Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332
Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340
The achievement of aerodynamic goals on the EH101 project through the 'single site' concept p 75 A92-56342
AS 332 MKII - Development and certification p 75 A92-56343
Double loop control law strategy and applications to helicopter [CERT-2/7724-DEFA] p 108 N92-19295
A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction [ONERA-RS-97/5094-PY] p 269 N92-21736
Repair procedures for advanced composites for helicopters [MBB-UD-0606-91-PUB] p 5 N92-29874

HELICOPTER ENGINES
The 1991 Cierva Lecture - Aberdeen and its influence on the evolution of the commercial IFR twin engined helicopter p 55 A92-43446
'A new proposal for an old problem' - The right engine for the right helicopter p 96 A92-56281
Lynx - A 50 year product? p 75 A92-56307

HELICOPTER PERFORMANCE

Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements [ONERA, TP NO. 1991-157] p 9 A92-16125
Generalized higher harmonic control - Ten years of Aerospatiale experience p 104 A92-35769
LAH main rotor model test at the DNW p 70 A92-35771
The computation and validation of hovering rotor performance p 74 A92-56285
Robust control system design with application to high performance helicopters p 108 A92-19621
A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
EH 101 ship interface trials: Flight test programme and preliminary results p 82 N92-21964
United Kingdom approach to deriving military ship helicopter operating limits p 82 N92-21966

HELICOPTER TAIL ROTORS

A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741

HELICOPTER WAKES

Experimental and computational studies of hovering rotor flows p 22 A92-46954
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958

The computation and validation of hovering rotor performance p 74 A92-56285

HELICOPTERS

The Eurofar vehicle overview p 67 A92-14416
Innovation in the laser warning sensor field p 89 A92-35742
Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
Progress towards quieter civil helicopters p 267 A92-52847
Real-time helicopter simulation using the blade element method p 264 A92-56278
Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
Limitations on helicopter operations in the aeronaval environment p 82 N92-21973
Aircraft ship operations [AGARD-AR-312] p 85 N92-28468
Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
LAH-main rotor model test at the DNW [NLR-TP-90305-U] p 87 N92-28687

HELIUM

Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507

HELIUM ISOTOPES

Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
Superfluid vortex nucleation in He-3 flow p 271 N92-10479
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 N92-21763
Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788
Ultrasonic investigation of (3)He-A vortices in low magnetic fields [PB92-142256] p 265 N92-23665

HELMET MOUNTED DISPLAYS

Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008
Does the future lie in binocular helmet display? p 253 N92-19019
The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 N92-28539

HELMETS

Fixed wing night attack EO integration and sensor fusion p 253 N92-19009
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 N92-19013

HEMODYNAMIC RESPONSES

Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180

HERMES MANNED SPACEPLANE

Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
Sweden and the space plane - A small country with high ambition [AIAA PAPER 91-5005] p 119 A92-17804
The Hermes search and rescue operations in the open sea [AIAA PAPER 91-4099] p 128 A92-24357
Is the avionics system of the Hermes Spaceplane centralized or decentralized? p 139 A92-49258
Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 N92-15040
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774

HETERODYNING

Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project p 209 N92-24363
Millimeter wave technology in space p 283 N92-25782

HETEROGENEITY

Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541

HIGH ACCELERATION

High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

HIGH ALTITUDE

Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

HIGH ALTITUDE BALLOONS

The Norwegian sounding rocket and balloon programme p 122 N92-24594

HIGH CURRENT

Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678

HIGH POWER LASERS

Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 N92-34152

HIGH RESOLUTION

Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 N92-27678

HIGH REYNOLDS NUMBER

High resolution schemes for steady flow computation p 161 A92-10036
Numerical flow visualization of high Reynolds number recirculated flows using an animation technique [ONERA, TP NO. 1991-215] p 168 A92-26367
The installation of the AVRO 9 by 7 foot low-speed wind tunnel at the University of Manchester (England) [AERO-REPT-9005] p 114 N92-18341

HIGH SPEED

Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55] p 187 N92-12216

HIGH SPEED CAMERAS

Development of an electronic high speed camera system for the quantitative analysis of unsteady flows [MPIS-100/1991] p 209 N92-17344

HIGH STRENGTH

Innovative constituents requirements to improve composites compressive strength p 146 N92-33043

HIGH TEMPERATURE

High temperature processing and deformation of a near-alpha titanium alloy
[PNR-90853] p 149 N92-20911

HIGH TEMPERATURE GASES

Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315
Hot-gas reingestion - Engine response considerations p 95 A92-45317

HIGH TEMPERATURE SUPERCONDUCTORS

Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897
High temperature superconducting vortex flow transistor p 159 A92-38971
Observation of inverse domains in high Tc superconductors p 273 A92-52211
Dynamics of vortices in high-temperature superconductors p 273 A92-10501
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors p 273 A92-21635
Vortex lattice-vortex liquid states in anisotropic high-T sub c) superconductors
[PB92-142421] p 273 A92-22738
Vortex dynamics in artificially fabricated superconducting networks
[ETN-92-91296] p 160 A92-25307
Magnetic suspension using high temperature superconducting cores p 161 A92-27789

HIGH TEMPERATURE TESTS

High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982

HIGHLY MANEUVERABLE AIRCRAFT

Aerodynamic development of the X-31 aircraft for the high angle of attack region
[MBB-FE211-S-PUB-452] p 77 A92-17313

HIGHWAYS

Dense fog on the highway: Visual range monitoring in cars? p 241 A92-31106

HIPPARCOS SATELLITE

Power system performance prediction for the Hipparcos spacecraft p 141 A92-13155

HISTOGRAMS

Airborne lidar and radiometric observations of PBL- and low clouds p 240 A92-31037

HISTORIES

36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
Eighty years of aerospace technique through ATMA bulletins
[ETN-91-90097] p 286 A92-11963
The evolution of the bypass engine
[PNR-90832] p 99 A92-21850

HODOGRAPHS

Extended mapping and characteristics techniques for inverse aerodynamic design p 76 A92-13949

HOLES (MECHANICS)

Dynamic wind tunnel tests on control of forebody vortices with suction p 107 A92-18793

HOLOGRAPHY

Holographic dispersive concentrators for photovoltaic power generators p 142 A92-13236

HOMOGENEITY

Aeroacoustics in inhomogeneous flow field
[FFA-TN-1991-30] p 268 A92-12601

HOMOGENEOUS TURBULENCE

Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
Experimental and theoretical investigation of a homogeneous turbulent shear flow
[ONERA, TP NO. 1992-43] p 180 A92-48604

HORIZONTAL TAIL SURFACES

Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack
[ESDU-91031] p 39 A92-15971

HORSESHOE VORTICES

Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516

HOSPITALS

The CSMA/CD local area network for hospital services p 157 A92-15284

HOT WORKING

Cost effective solutions for titanium sheet metal forming p 211 A92-22785

HOT-WIRE ANEMOMETERS

A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
Hot-wire measurements in turbulent transonic flows p 26 A92-53078
Characteristics of a boundary layer in a leading edge vortex p 31 A92-13012

HOT-WIRE FLOWMETERS

A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory p 184 A92-55479

HOTOL LAUNCH VEHICLE

Ground operations of a HTOL airbreathing launcher [IAF PAPER 91-217] p 125 A92-14708

HOVERING

Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method
[ONERA, TP NO. 1991-177] p 10 A92-16139
Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors
[ONERA, TP NO. 1991-178] p 10 A92-16140
Experimental and computational studies of hovering rotor flows p 22 A92-46954
The computation and validation of hovering rotor performance p 74 A92-56285

HUMAN BEHAVIOUR

The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998

HUMAN CENTRIFUGES

G-tolerance and spatial disorientation: Can simulation help us? p 248 A92-28534

HUMAN FACTORS ENGINEERING

A conceptualization of aviation psychology on the civil flight deck p 250 A92-13849
British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023
The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994
Reliability modeling for non-electronic systems p 216 A92-18633

Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 A92-19008
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 A92-19013
The COMPAS system in the ATC environment
[DLR-MITT-91-08] p 62 A92-19041
The role of planning systems in future air traffic management p 64 A92-19050
ESA standardisation process through the example of manned spacecraft atmospheres p 253 A92-25842
Moon base habitability aspects p 254 A92-27026

HUMAN PERFORMANCE

How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308
Learning from aircraft accidents and incidents p 54 A92-39310

HUMAN REACTIONS

Pilot attitudes to cockpit automation p 250 A92-44926

HUMAN RESOURCES

Human resource management in aviation --- Book p 250 A92-13837

HUMAN TOLERANCES

Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956

HUMIDITY MEASUREMENT

Use of relative humidity sensors for planes measurement p 89 A92-32080

HYBRID PROPELLANT ROCKET ENGINES

Introduction of the solid fuel combustion chamber project p 142 A92-22269

HYDRAULIC JETS

Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet
[ETN-92-91161] p 213 A92-21993

HYDRODYNAMIC EQUATIONS

The hydrodynamics of aspherical planetary nebulae. I
- Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171

HYDRODYNAMICS

Vectorising the smooth particle hydrodynamics p 161 A92-10037
Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
A Spectral model for turbulent transport p 178 A92-45095
Effect of viscous damping on the response of floating bodies p 187 A92-14303
Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 A92-24411
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 A92-25875

HYDROELASTICITY

A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 A92-23846

HYDROGEN EMBRITTLEMENT

Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 A92-28643

HYDROGRAPHY

An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 A92-17169
Seaborne lidar system p 224 A92-23389

HYDROXYL RADICALS

Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances p 232 A92-55441

HYGROMETERS

Use of relative humidity sensors for planes measurement p 89 A92-32080

HYPERBOLIC DIFFERENTIAL EQUATIONS

Concerning the functional solution of transonic flows p 11 A92-21318
Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 A92-27678
Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 A92-30514

HYPERBOLIC FUNCTIONS

Panel method control in 3-D hyperbolic grid generation p 17 A92-39940
Hyperbolic grid generation with BEM source terms [NLR-TP-90334-U] p 264 A92-28635
Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 A92-29604

HYPERSONIC AIRCRAFT

French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683

HYPERSONIC BOUNDARY LAYER

Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
Models of turbulence in a hypersonic boundary layer p 19 A92-41817
Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
Hypersonic boundary layers: Transition and turbulence effects p 188 A92-14976
Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 A92-14991
Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 A92-14994
A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 A92-19294
Hypersonic wakes [ETN-92-91082] p 41 A92-19925
Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 A92-22179
Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation p 42 A92-22183
Instability and transition in compressible boundary layers [AD-A248596] p 201 A92-28062

HYPERSONIC FLIGHT

Hypersonic materials p 143 A92-18002
French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
Propulsion system performance and integration for high Mach air breathing flight p 96 A92-46429
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 A92-15017
Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 A92-15027
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 A92-23836
Application of finite element method to hypersonic nozzle flow computations p 199 A92-27479
Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 A92-29649
LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 A92-70983

HYPERSONIC FLOW

- Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815
- Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations [ONERA, TP NO. 1991-131] p 9 A92-16107
- Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
- An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-26269
- Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
- Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
- Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
- Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
- Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734
- Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
- Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- The SR3 low density wind tunnel - Facility capabilities and research development [AIAA PAPER 92-3972] p 112 A92-56798
- An aerodynamic consideration of the re-entry and aerobraking environment of space vehicles [IAF PAPER ST-92-0017] p 27 A92-57363
- Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 A92-10988
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 A92-14973
- Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 A92-14978
- Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 A92-14981
- A multiblock flow solver for inviscid hypersonic flows p 34 A92-14986
- Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 A92-14989
- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 A92-14990
- Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 A92-14992
- Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 A92-15003
- Verification and application of the NSFLEX method for hypersonic flow conditions p 36 A92-15005
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006
- Efficient solution of three-dimensional viscous hypersonic flows p 37 A92-15007
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
- Influence of chemical modelling on hypersonic flow p 37 A92-15015
- The dynamic response of separated hypersonic flows p 38 A92-15019
- Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 A92-15023
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 A92-15025
- Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 A92-15031
- Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 A92-15032
- Transitional flows around re-entry bodies p 38 A92-15035
- Grid impact on 3D hypersonic flows p 39 A92-15041
- Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 A92-17311

- Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 A92-18231
- Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 A92-18232
- Towards the computation of turbulent hypersonic flows [AERO-REPT-9106] p 40 A92-18318
- Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296
- Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 A92-21703
- Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 A92-22179
- Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 A92-23168
- CFD contributions during hypersonic airplane intake design p 199 A92-27472
- Nonequilibrium 3D flows of air through inlets p 200 A92-27487
- Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 A92-27671
- Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728-] p 48 A92-28789
- Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 A92-29713
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB/FE211/S/PUB/466] p 204 A92-30674
- CFD contributions during hypersonic airplane intake design [MBB/FE213/S/PUB/459] p 50 A92-30676
- Flat plates placed in depleted hypersonic flow [SESSIA-430/91.960] p 50 A92-31508
- HYPERSONIC HEAT TRANSFER**
- Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 A92-29713
- HYPERSONIC INLETS**
- Air intakes for high speed vehicles [AGARD-AR-270] p 41 A92-20797
- CFD contributions during hypersonic airplane intake design [MBB/FE213/S/PUB/459] p 50 A92-30676
- HYPERSONIC NOZZLES**
- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 A92-15018
- Application of finite element method to hypersonic nozzle flow computations p 199 A92-27479
- HYPERSONIC REENTRY**
- Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- Simulation of hypersonic flows on unstructured grids p 15 A92-31496
- Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
- Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
- Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 A92-14987
- Fast finite element solvers for reentry flows p 35 A92-14988
- Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 A92-14989
- Verification and application of the NSFLEX method for hypersonic flow conditions p 36 A92-15005
- Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 A92-15012
- Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296
- HYPERSONIC SHOCK**
- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 A92-14991
- HYPERSONIC VEHICLES**
- Orilamme - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles [IAF PAPER 91-207] p 126 A92-14705
- Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- Potential hypersonic vehicles applications [AIAA PAPER 91-5086] p 1 A92-17854

- Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143
- The German Hypersonics Technology Programme - Status report 1992 [IAF PAPER 92-0867] p 127 A92-57258
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 A92-15033
- Hypersonic configurations in slow speed flight p 43 A92-24394
- CFD contributions during hypersonic airplane intake design p 199 A92-27472
- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB/FE202/S/PUB/461] p 5 A92-30232
- CFD contributions during hypersonic airplane intake design [MBB/FE213/S/PUB/459] p 50 A92-30676
- HYPERSONIC WAKES**
- Hypersonic wakes [ETN-92-91082] p 41 A92-19925
- HYPERSONIC WIND TUNNELS**
- Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence [ONERA, TP NO. 1991-94] p 206 A92-16077
- Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
- New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321
- Compression ramp in rarefied gas [RC-90-08] p 29 A92-11978
- Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 A92-11979
- Numerical simulations around models in hypersonic wind tunnels p 36 A92-14998
- Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
- HYPERTENSION**
- G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 A92-18984
- HYPERVELOCITY IMPACT**
- Protection of spacecraft against meteoroid/orbital debris impacts p 134 A92-23786
- HYPOXIA**
- G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 A92-18984
- ICE**
- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 A92-21679
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 A92-21692
- ICE CLOUDS**
- In situ measurements of the ice water content in cirrus clouds p 236 A92-22952
- Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 A92-29306
- ICE ENVIRONMENTS**
- Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- ICE FORMATION**
- Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds --- for aircraft icing p 53 A92-23302
- Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 A92-20573
- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 A92-21679
- Regulations and their changes for certification of civil aircraft in icing conditions p 56 A92-21683
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 A92-21692
- The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 A92-31813
- Analysis of three icing test flights reaching the aircraft-referred icing degree of severe [ESA-TT-1254] p 58 A92-31943
- ICE PREVENTION**
- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 A92-21679
- A review of icing research at the Royal Aerospace Establishment p 56 A92-21689

- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- ICELAND**
An investigation of cold overflow over the Iceland/Faeroes Ridge [AD-A243084] p 242 N92-17169
- IDEAL FLUIDS**
On the Arnol'd stability criterion for steady-state flows of an ideal fluid p 165 A92-21506
- IDEAL GAS**
Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- IMAGE ANALYSIS**
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
- IMAGE INTENSIFIERS**
Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
- IMAGE PROCESSING**
A SAR processor for a GIS environment p 155 A92-34980
Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548
A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321
Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 N92-11288
Three-dimensional computer graphics in flow visualization p 189 N92-16227
Development of an electronic high speed camera system for the quantitative analysis of unsteady flows [MPIS-100/1991] p 209 N92-17344
Does the future lie in binocular helmet display? p 253 N92-19019
Approach and landing assisted by onboard image processing p 64 A92-21959
Testing of an experimental photographic reconnaissance system p 209 N92-25602
- IMAGE RESOLUTION**
A large format film camera for high precision object recording p 207 A92-51630
- IMAGE VELOCITY SENSORS**
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- IMAGERY**
The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544
- IMMUNE SYSTEMS**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- IMPACT DAMAGE**
Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088
CFRP stiffened panels under compression p 146 N92-33044
- IMPACT LOADS**
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382
- IMPACT TESTS**
Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
- IMPACTORS**
Low pressure impactor with electrical concentration detection p 209 N92-10534
- IN SITU MEASUREMENT**
State of composite material structure control in situ p 215 A92-54862
- IN-FLIGHT MONITORING**
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
The SAS Flight Analysis and Aircraft Monitoring System p 89 A92-35941
Proposal for the new fatigue management system for the AMX p 78 N92-18580
Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603
- INCIDENCE**
An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 N92-13015

- INCOHERENT SCATTER RADAR**
Long-lived polar atmospheric vortices - A combined radar and optical study p 230 A92-10629
- INCOMPRESSIBLE BOUNDARY LAYER**
An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206
Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 N92-70561
- INCOMPRESSIBLE FLOW**
Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
On the Arnol'd stability criterion for steady-state flows of an ideal fluid p 165 A92-21506
Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703
Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289
The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
Internal flow modelling of vortex throttles p 168 A92-27385
Numerical fluid mechanics - Incompressible flows with complex boundaries --- Book [ISBN 3-540-53137-8] p 169 A92-29649
Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
Well-posedness in the generalized sense for the incompressible Navier-Stokes equation p 262 A92-37789
Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617
Modeling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124
Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 N92-12219
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates p 187 N92-14321
The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 N92-18291
A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 N92-19294
Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
Finite element methods for flow problems p 200 N92-27672
A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates p 203 N92-30454
Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765
Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166
- INCOMPRESSIBLE FLUIDS**
The multiparameter method of a boundary layer on thin bodies of revolution p 165 A92-21613
An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 N92-14328

- Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 N92-24963
- INDEXES (DOCUMENTATION)**
Aeronautical Engineering Group publications, 1950 - present [AERO-REPT-8907] p 202 N92-29683
- INDUCED DRAG**
Effect of a deicing device on the induced drag of a lifting airfoil p 74 A92-51947
Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193
- INDUSTRIAL MANAGEMENT**
Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
Concurrent engineering p 260 N92-30952
Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- INDUSTRIES**
Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 N92-18632
Market directed thinking in a technological operation p 276 N92-23929
MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686
- INERTIA**
On inertial waves in the earth's fluid core p 231 A92-37905
- INERTIAL NAVIGATION**
An integrated navigation system manager using federated Kalman filtering p 90 A92-48477
Management of navigation means failure in Hermes space vehicle p 136 N92-24467
- INERTIAL REFERENCE SYSTEMS**
Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600
Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601
- INFORMATION DISSEMINATION**
How to circulate official terminology [IAF PAPER 92-0346] p 277 A92-55761
- INFORMATION MANAGEMENT**
Columbus user support organization concept in Italy p 119 A92-32465
ELS for the A340 --- Electronic Library System [SAE PAPER 912111] p 89 A92-39963
Normalization, reliability and validation of information for spatial operations p 157 N92-15285
Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659
Transfers of technology: International negotiations and work in progress p 278 N92-18665
Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 N92-20611
- INFORMATION PROCESSING (BIOLOGY)**
Decision support in the cockpit - Probably a good thing? p 251 A92-11135
Does the future lie in binocular helmet display? p 253 N92-19019
- INFORMATION SYSTEMS**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
ELS for the A340 --- Electronic Library System [SAE PAPER 912111] p 89 A92-39963
A systematic formulation, as an approach to air traffic [MBB-Z-0371-91-PUB] p 62 N92-10996
Space electronic display panel p 278 N92-25787
- INFORMATION THEORY**
Reasoning with uncertain and incomplete information in aerospace applications p 261 N92-12544
- INFORMATION TRANSFER**
Normalization, reliability and validation of information for spatial operations p 157 N92-15285
- INFRARED ABSORPTION**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
- INFRARED DETECTORS**
Aircraft experiments with visible and infrared sensors p 206 A92-37159
An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222
Passive optical and IR sensors [MBB-UH-HE512] p 224 N92-23392

INFRARED FILTERS

Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment [A0056] p 272 N92-27108

INFRARED IMAGERY

Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430

Time-to-go estimation from infrared images p 61 A92-48308

Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020

Thermographic gust wind tunnel measurements [ONERA-RF-31/3409-PY] p 29 N92-11972

Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994

INFRARED PHOTOGRAPHY

Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003

INFRARED RADIATION

TIMS calibration correction by comparison with PRT5 p 223 N92-11412

Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506

Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378

INFRARED RADIOMETERS

Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302

Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321

Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037

INFRARED SCANNERS

Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124

Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 N92-15002

INFRARED SIGNATURES

Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392

INFRARED TELESCOPES

Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project p 209 N92-24363

INFRARED TRACKING

An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222

INFRARED WINDOWS

Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126

The near millimetre wavelength optical constants of calcium lanthanum sulphide --- for IR window applications in high-speed aircraft p 272 A92-52965

INGESTION (ENGINES)

Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315

Hot-gas reingestion - Engine response considerations p 95 A92-45317

INHOMOGENEITY

Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-08867] p 192 N92-19349

INJURIES

Aircraft accident report: Unstabilized approach and loss of control NPA, Inc. dba United Express Flight 2415, British Aerospace BA-3101, N410UE, Tri-Cities Airport, Pasco, Washington, December 26, 1989 [PB91-910406] p 56 N92-21873

Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241

INLET AIRFRAME CONFIGURATIONS

Air intakes for high speed vehicles [AGARD-AR-270] p 41 N92-20797

INLET FLOW

Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667

An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770

Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599

Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055

Radial inflow turbine study [AD-A240169] p 96 N92-11015

Supersonic flow in compression stages and inlets p 43 N92-24395

Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464

Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926

INLET PRESSURE

Calculation of installation effects within performance computer programs p 102 N92-28465

INSOMNIA

Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703

INSPECTION

A concept for the revisions of structural inspection schedules p 215 N92-14431

The Operational Loads Monitoring System, OLMS p 79 N92-18586

Training guidelines in non-destructive testing techniques [DE92-615083] p 217 N92-23258

Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123

Survey of French activities concerning structural airworthiness and aging aircraft p 57 N92-30130

INSTRUMENT ERRORS

In situ measurements of the ice water content in cirrus clouds p 236 A92-22952

INSTRUMENT FLIGHT RULES

The 1991 Cierva Lecture - Aberdeen and its influence on the evolution of the commercial IFR twin engine helicopter p 55 A92-43446

Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895

INSTRUMENT LANDING SYSTEMS

Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601

PROCRU simulation results compared with Metro 2 in-flight ILS approach data [PB92-138502] p 67 N92-70564

INSURANCE (CONTRACTS)

Insurance turns the corner p 278 A92-20516

Reducing risks p 278 A92-22725

Insurers lose from high-risk deals p 279 A92-35474

CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549

Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550

INTAKE SYSTEMS

Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993

CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450

Nonequilibrium 3D flows of air through inlets p 200 N92-27487

INTEGRAL EQUATIONS

A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098

INTEGRALS

An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206

INTEGRATED CIRCUITS

Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379

INTELSAT SATELLITES

Lite-Sat's for specific communication tasks p 156 N92-15232

INTERACTIONAL AERODYNAMICS

Steady and unsteady 3D interactive boundary layers p 161 A92-10689

Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815

Detailed analysis of wing-nacelle interaction for commercial transport aircraft [ONERA, TP NO. 1991-152] p 9 A92-16122

Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements [ONERA, TP NO. 1991-157] p 9 A92-16125

Supersonic stator-rotor interaction in a turbine stage [ONERA, TP NO. 1991-166] p 10 A92-16133

Theoretical study and prediction of BVI noise including close interactions [ONERA, TP NO. 1991-174] p 265 A92-16138

Computational methods in viscous aerodynamics --- Book p 11 A92-21976

Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil [AIAA PAPER 92-0027] p 11 A92-22149

Experimental and theoretical studies on helicopter rotor fuselage interaction

[ONERA, TP NO. 1991-197] p 13 A92-26356

Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000

Cylinder-induced shock-wave boundary-layer interaction p 15 A92-31188

Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347

Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method [ONERA, TP NO. 1992-1] p 23 A92-48577

A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028

Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734

Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748

Rarefied gas flow around a disc with different angles of attack p 25 A92-52753

Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755

Force and heat transfer on a disc in rarefied flow p 25 A92-52764

Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770

The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849

The interaction between a high-frequency gust and a blade row p 267 A92-54484

Trimming rotor blades with periodically deflecting trailing edge flaps p 106 A92-56283

Current European research activities in helicopter interactional aerodynamics p 75 A92-56330

Airframe noise p 268 N92-10605

Compression ramp in rarefied gas [RC-90-08] p 29 N92-11978

An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023

Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985

Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 N92-14995

Contribution of fin and tailplane to sideslip and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack [ESDU-91031] p 39 N92-15971

VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323

National user interfaces p 224 N92-23407

INTERFACES

National user interfaces p 224 N92-23407

INTERFACIAL ENERGY

Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089

Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234

Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 N92-18340

INTERFACIAL TENSION

Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540

Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760

Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897

INTERNAL COMBUSTION ENGINES

Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297

INTERNAL WAVES

Physical and computational modelling of stratified shear flows [AERO-REPT-8909] p 190 N92-17974

Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 N92-18340

INTERNATIONAL COOPERATION

Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134

International standardisation of regulations for gust loading calculations p 68 A92-22473

USO concept in the member states - Belgium p 119 A92-32466

A European perspective on the co-operative air traffic management concept p 60 A92-33427

Sunrise aerospace --- technology development in the Pacific Rim p 3 A92-46448

German-GUS cooperation in civil aviation p 3 A92-47592

Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454

- The Swedish space program p 121 A92-53452
The Norwegian space programme p 121 A92-53453
The French space programme p 121 A92-53458
European Space Agency - Achievements and perspectives p 121 A92-53459
Experiences during a 14 months overwintering with respect to potential human habitation on other planets [IAF PAPER 92-0249] p 244 A92-55688
Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353
The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 A92-14046
Activities report of the European Space Agency [ETN-92-90679] p 286 A92-15961
International collaboration in PA and safety, the Eurospace PA-Panel p 215 A92-18608
Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 A92-18661
EC funding of collaborative research projects [PNR-90833] p 279 A92-21851
Spin-offs of the solid fuel combustion chamber project p 143 A92-22275
Planetary vision as a strategy p 229 A92-25243
Society of space studies p 283 A92-25762
International Space University: Experiences and observations during Summer 1989 p 275 A92-25786
Multi-cultural components and keys for European worldwide space programs p 122 A92-27008
Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 A92-29879
- INTERNATIONAL LAW**
Selected pitfalls and booby-traps in aircraft finance p 280 A92-35587
Security rights in aircraft under Belgian law p 280 A92-35589
Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591
Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548
CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549
Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550
Intellectual Property Rights [AGARD-LS-181] p 277 A92-18659
- INTERNATIONAL RELATIONS**
Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762
- INTERNATIONAL SPACE YEAR**
Main activities conducted under the International Space Year Panel of Experts on Education and Applications [IAF PAPER 92-0466] p 274 A92-55806
Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 A92-29879
- INTERNATIONAL TRADE**
Sunrise aerospace --- technology development in the Pacific Rim p 3 A92-46448
Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 A92-13076
- INTERPOLATION**
TRANSF3: A 3-D grid generator based on transfinite interpolation [PB92-151919] p 259 A92-25519
Finite element simulation of viscoelastic flow p 205 A92-34038
- INTERPROCESSOR COMMUNICATION**
Architecture and interconnects of programmable processors of radar signals p 159 A92-23042
Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 A92-29615
- INTERSTELLAR TRAVEL**
Use of natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644
- INVARIANCE**
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 A92-14321
- INVENTIONS**
Catalogue of ESA patents [ESA-SP-1131-REV-1] p 287 A92-19411
- INVERSE KINEMATICS**
Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 A92-28581
- INVISCID FLOW**
Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
Topology of steady flows of low viscosity fluids p 162 A92-11219
Secondary separation from a slender wing p 6 A92-13448
Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455
Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
An unfactored implicit scheme for 3D inviscid transonic flows [AIAA PAPER 92-2668] p 20 A92-45523
Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546
Calculation of potential flow around airfoils using a discrete vortex method p 21 A92-45827
The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441
A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 A92-12219
A multiblock flow solver for inviscid hypersonic flows p 34 A92-14986
Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 A92-14997
Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 A92-15025
VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 A92-18323
Inviscid drag prediction for transonic transport wings using a full-potential method [NLR-TP-89365-U] p 41 A92-20473
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 A92-21703
Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 A92-21704
Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 A92-22180
A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 A92-22193
Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 A92-23251
NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 A92-27947
Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration [ONERA-RSF-7/3617-AY-022A] p 48 A92-29206
- ION PROPULSION**
The enhancement of the Italsat spacecraft - A step forward the communication satellites [IAF PAPER 91-473] p 131 A92-18494
- IONIZING RADIATION**
Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301
- IONOSPHERIC CURRENTS**
Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089
- IONOSPHERIC SOUNDING**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- IRRADIANCE**
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 A92-11404
- ISCHEMIA**
Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405
- ISOTHERMAL FLOW**
Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967
- ISOTROPIC TURBULENCE**
Velocity correlation in isotropic turbulence according to a modified Obukhov theory p 169 A92-28950
Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 A92-29972
A subgrid-scale model based on the second-order velocity structure function p 203 A92-30651
- ISOTROPY**
Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 A92-24963
- ITALIAN SPACE PROGRAM**
A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development [IAF PAPER 91-288] p 130 A92-14714
The enhancement of the Italsat spacecraft - A step forward the communication satellites [IAF PAPER 91-473] p 131 A92-18494
Columbus user support organization concept in Italy p 119 A92-32465
Space activities in Italy p 121 A92-53457
- ITERATIVE SOLUTION**
An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704
The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
Blade design and analysis using a modified Euler solver p 97 A92-13952
Cell vertex methods for compressible gas flows p 197 A92-26599
- J**
- JET AIRCRAFT**
Ageing airliner census - Still flying safely p 54 A92-38374
Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
Steels for aerospace applications p 149 A92-52983
Effective cueing during approach and touchdown: Comparison with flight p 117 A92-28552
- JET AIRCRAFT NOISE**
The sonic boom and problems related to supersonic flights of military aircraft [ONERA, TP NO. 1991-162] p 9 A92-16129
Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353
Silent solutions --- noise suppression for Stage 3 corporate fleets p 96 A92-53120
Jet noise classical theory and experiments p 268 A92-10602
Jet aircraft noise at high subsonic flight Mach numbers [DLR-FB-91-28] p 270 A92-29997
Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 A92-32960

Pilot noise exposure during a Boeing 747-400 round trip:
Judgement of noise and analysis in respect to hearing
impairment of pilots p 271 N92-32961

JET CONTROL

Experimental investigation of transverse jet effects
related to hypersonic space vehicles p 36 N92-14995

JET ENGINES

The selective bleed variable cycle engine --- aircraft
propulsion [ASME PAPER 91-GT-388] p 93 A92-15720

Hot-gas reingestion - Engine response considerations
p 95 A92-45317

Jet noise classical theory and experiments
p 268 N92-10602

Recent progress in inverse methods in France
p 97 N92-13938

Air intakes for high speed vehicles
[AGARD-AR-270] p 41 N92-20797

The evolution of the bypass engine
[PNR-90832] p 99 N92-21850

JET FLOW

The jet edge-tone feedback cycle - Linear theory for
the operating stages p 167 A92-24758

Numerical simulation of nonreactive flows with
transverse jet using Euler and laminar Navier-Stokes
codes

[ONERA, TP NO. 1991-237] p 13 A92-26387

Measurements and modelling of the turbulent near wake
flow of a disk with a central jet p 174 A92-40123

Vorticity shedding and acoustic resonance in an in-line
tube bundle. I - Vorticity shedding. II - Acoustic
resonance p 176 A92-43045

On the development of Goertler vortices in wall jet
flow p 177 A92-44801

Prediction and measurement of jet flowfield features for
ASTOVL aircraft p 20 A92-45318

Discrete-phase effects on the flow field of a droplet-laden
swirling jet with recirculation - A numerical study
p 178 A92-45603

Characterization of subcritical and supercritical jets by
an acoustic imagery method

[ONERA, TP NO. 1992-34] p 267 A92-48595

Organized structures in the developing region of
axisymmetric jet flow p 182 A92-51892

Free molecular pressure probe measurements in the
continuum, transitional and free molecular regimes of a
free jet p 183 A92-52794

A comparison of numerical predictions and experiments
on under-expanded jets

[AIAA PAPER 92-4027] p 141 A92-56849

Experimental investigation of transverse jet effects
related to hypersonic space vehicles p 36 N92-14995

Experimental and analytical studies of jets in quiescent
or rotating flow fields p 193 N92-20317

Numerical simulation of turbulence at the back of the
airplane [ETN-92-91664] p 51 N92-32769

JET IMPINGEMENT

Computation of normal impinging jets in cross-flow and
comparison with experiment p 11 A92-22446

Impinging jets in cross-flow p 169 A92-28942

Turbulent energy budgets in impinging zones
p 17 A92-40081

Computation of impinging flows using second-moment
closures p 173 A92-40083

Second moment closure predictions of jet-on-jet
impingement flows p 173 A92-40102

Flow structure and mixing in obstructed and confined
jets p 174 A92-40107

Recent research into the aerodynamics of ASTOVL
aircraft in ground environment p 18 A92-40549

The experimental and computational study of jet
impingement flowfields with reference to VSTOL aircraft
performance p 20 A92-45324

The turbulence characteristics of a single impinging jet
through a crossflow p 180 A92-47676

Study of noise generated by the impingement of a hot
supersonic jet on an obstacle

[ONERA, TP NO. 1992-33] p 267 A92-48594

Impingement of an axisymmetric jet on unheated and
heated flat plates p 182 A92-50297

JET MIXING FLOW

The application of high pressure ejectors to reaction
control systems p 93 A92-16666

Flow structure and mixing in obstructed and confined
jets p 174 A92-40107

JET NOZZLES

CFD Techniques for Propulsion Applications
[AGARD-CP-510] p 198 N92-27450

JET PROPULSION

Concept and analysis of an integrated hydrojet
propulsion with a rotation symmetrical boundary layer
inlet

[ETN-92-91161] p 213 N92-21993

CFD Techniques for Propulsion Applications
[AGARD-CP-510] p 198 N92-27450

JET THRUST

Experimental investigation of transverse jet effects
related to hypersonic space vehicles p 36 N92-14995

JOINTS (JUNCTIONS)

Joining of composite materials to metals
p 211 A92-10695

ACLICO: An aid system for designing bonded joints
[REPT-911-430-134] p 152 N92-12146

Environmental resistance of amorphous bonded
thermoplastic joints p 146 N92-33053

JOSEPHSON JUNCTIONS

High temperature superconducting vortex flow
transistor p 159 A92-38971

JOURNAL BEARINGS

Determination of rotordynamic coefficients for labyrinth
seals and application to rotordynamic design
calculations p 213 N92-14360

JUNCTION TRANSISTORS

High temperature superconducting vortex flow
transistor p 159 A92-38971

K**K-EPSILON TURBULENCE MODEL**

Turbulence modelling for secondary flow prediction in
a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535

Navier-Stokes computation of airfoil in stall using
algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803

Numerical simulations of flows around flame holders
[AIAA PAPER 92-0557] p 168 A92-26967

Calculations of the dilution system in an annular gas
turbine combustor p 170 A92-31164

Performance of turbulence models to predict supersonic
boundary layer flows p 16 A92-37553

Computations of a separated turbulent boundary layer
p 174 A92-40131

Structure and modelling in strongly sheared turbulent
compressible flow p 175 A92-40161

Numerical prediction of boundary layers and transitional
flows p 196 A92-24342

Three dimensional flow in sharp bends --- ducted flow
p 200 N92-27481

The 3-D Navier-Stokes flow and temperature field
computation for a forced mixer nozzle p 200 N92-27482

Modelling the vaporiser and primary zone flows for a
modern gas turbine combustion chamber p 101 N92-27484

KALMAN FILTERS

An integrated navigation system manager using
federated Kalman filtering p 90 A92-48477

Four-dimensional data assimilation - Comparison of
variational and sequential algorithms p 239 A92-51783

KARMAN VORTEX STREET

A short or a long cylinder: What difference does it make
to the Karman vortex street? [MPIS-98/1990] p 40 N92-17314

Investigation on the control of a Karman vortex street
[MPIS-99/1990] p 40 N92-17315

Stochastic perturbed systems: Theory and practice of
Karman vortex streets [MPIS-4/1991] p 193 N92-20180

KINEMATIC EQUATIONS

Kinematic simulation of homogeneous turbulence by
unsteady random Fourier modes p 170 A92-31460

Quasi-recursive dynamics equations for
spacecraft-based flexible robotic manipulators
[NLR-TP-90028-U] p 261 N92-28648

KINEMATICS

Use of stepwise regression techniques and kinematic
compatibility for the analysis of EAP flight data
p 81 N92-18790

Modeling and simulation of complex mechanical systems
for space applications p 135 N92-24389

New results from FRECOPA analysis --- long duration
exposure facility p 213 N92-27304

KINETIC ENERGY

Turbulent energy budgets in impinging zones
p 17 A92-40081

KINETIC EQUATIONS

A boundary integral formulation for the kinetic field in
aerodynamics. II - Applications to unsteady 2D flows
p 14 A92-28005

KINETIC THEORY

The Harold Grad Lecture - Mathematics and the
Boltzmann equation p 274 A92-52702

Transport coefficients in discrete kinetic theory and
comparison with classical fluid dynamics p 274 A92-52782

Shock-wave onset with chemical dissociation by the
discrete Boltzmann equation p 182 A92-52785

KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)

Real-time mechanisms in a multibase knowledge
system p 264 A92-20345

The TSE 310 troubleshooting expert prototype for the
Airbus A-310 commercial aircraft p 2 A92-25180

Vibration analysis of gas turbines by an intelligent
knowledge-based system p 95 A92-40548

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Application of knowledge-based systems for diagnosis
of aircraft systems [NLR-TP-90192-U] p 57 N92-28655

KNOWLEDGE REPRESENTATION

Knowledge transfer and support systems in fighter
aircraft p 251 A92-45047

Knowledge transfer and anticipation in airline piloting
p 250 A92-45065

The role of planning systems in future air traffic
management p 64 N92-19050

Delfi: Design, development, and applicability of expert
systems shells [ISBN-90-6275-734-0] p 259 N92-25306

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

Knowledge-based planning for controlled airspace flight
operation as part of a cockpit assistant p 66 N92-27895

- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
- Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978
- Computation of laminar flow over cavities (AERO-REPT-9013) p 191 N92-18235
- The laminar natural convection on a horizontal surface (AERO-REPT-9015) p 191 N92-18236
- On the approximate representation of velocity and shear stress distributions in low-speed boundary layers (AERO-REPT-9012) p 192 N92-18319
- A deficit approach to three dimensional incompressible flows (CERT-RF-39/5025-36) p 192 N92-19294
- Hypersonic wakes (ETN-92-91082) p 41 N92-19925
- Boundary layer transition on concave surfaces p 195 N92-22200
- Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers (FFA-TN-1991-40) p 43 N92-23168
- Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476
- Special Course on Skin Friction Drag Reduction (AGARD-R-786) p 44 N92-27706
- Basic concepts on boundary layers p 44 N92-27707
- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region (ESA-TT-1237) p 205 N92-33996
- LAMINAR FLOW AIRFOILS**
- The design and testing of an airfoil with hybrid laminar flow control (ONERA, TP NO. 1992-22) p 24 A92-48585
- The A320 laminar fin programme (ONERA, TP NO. 1992-23) p 73 A92-48586
- The windtunnel as a tool for laminar flow research (NLR-TP-90145-U) p 117 N92-28661
- LAMINAR MIXING**
- Marco contract report (ETN-92-91077) p 193 N92-20232
- LAMINATES**
- Aerospace Arall - A challenge for the aircraft designer p 143 A92-10232
- The evolution from bonded F27 aircraft to Arall structures p 3 A92-41177
- Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197
- An integrated approach to developing tough epoxies p 145 A92-51563
- Repair procedures for advanced composites for helicopters p 4 A92-56277
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests (INFORME-I-522/90) p 145 N92-10068
- Bulging of fatigue cracks in a pressurized aircraft fuselage (LFR-655) p 77 N92-14045
- Repair procedures for advanced composites for helicopters (MBB-UD-0606-91-PUB) p 5 N92-29874
- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials (ETN-92-91613) p 146 N92-30414
- CFRP stiffened panels under compression p 146 N92-33044
- Global/local interlaminar stress analysis of a grid-stiffened composite panel (NASA-CR-190822) p 221 N92-33139
- LAND MOBILE SATELLITE SERVICE**
- The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system p 58 A92-13851
- Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 N92-30941
- LAND USE**
- NATO CCMS aircraft noise study on receiver technology p 226 A92-39050
- DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
- LANDING AIDS**
- The new airport aeronautic meteorological codes p 235 A92-13855
- JAS 39 Gripen progress report p 67 A92-16058
- Infra-red offers new landing aid competition p 88 A92-18937
- The Hermes nominal landing sites (IAF PAPER 92-0884) p 125 A92-57272
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Approach and landing assisted by onboard image processing p 64 N92-21959
- Approach and landing guidance p 65 N92-21960
- Limitations on helicopter operations in the aeronaval environment p 82 N92-21973
- ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679
- LANDING GEAR**
- Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- LANDING SITES**
- The Hermes nominal landing sites (IAF PAPER 92-0884) p 125 A92-57272
- LANDSAT 5**
- Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- LANGUAGES**
- An attempt to unify space terminology - The Multilingual Terminology Data Base (IAF PAPER 92-0343) p 277 A92-55758
- LANTHANUM COMPOUNDS**
- The near millimetre wavelength optical constants of calcium lanthanum sulphide --- for IR window applications in high-speed aircraft p 272 A92-52965
- LARGE SPACE STRUCTURES**
- Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410
- Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133
- Problems experienced by man when constructing giant structures in space p 251 A92-40438
- Control strategies for space systems p 137 N92-24494
- SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- LASER ANEMOMETERS**
- Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
- Radial inflow turbine study (AD-A246938) p 101 N92-28073
- Potential applications of laser Doppler anemometry for in-flight measurements (NLR-TP-90163-U) p 92 N92-28654
- Comparison of LDA and LTA applications for propeller tests in wind tunnels (NLR-MP-88031-U) p 47 N92-28658
- Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- Selection of a laser anemometer technique for propeller tests in wind tunnels (PB92-138510) p 118 N92-70563
- LASER APPLICATIONS**
- Set-up and alignment aspects of a CO2-laser radar for applications in the field (FEL-91-A162) p 158 N92-25378
- Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- LASER BEAMS**
- Innovation in the laser warning sensor field p 89 A92-35742
- LASER CUTTING**
- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- Successful transfer of technology from a research and development laboratory to an Aerospatiale production unit p 4 A92-51808
- LASER DOPPLER VELOCIMETERS**
- Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
- Aerosol behavior in supersonic flows (ONERA, TP NO. 1991-155) p 206 A92-16124
- Spectral analysis with a LDA in high speed flow p 209 A92-54339
- Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 (AIAA PAPER 92-3956) p 112 A92-56784
- Study of a technique of low level turbulence detection (ETN-91-90107) p 186 N92-12215
- Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry (REPT-90/55) p 187 N92-12216
- Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow (ONERA-NT-1991-9) p 193 N92-19932
- Potential applications of laser Doppler anemometry for in-flight measurements (NLR-TP-90163-U) p 92 N92-28654
- Comparison of LDA and LTA applications for propeller tests in wind tunnels (NLR-MP-88031-U) p 47 N92-28658
- Selection of a laser anemometer technique for propeller tests in wind tunnels (PB92-138510) p 118 N92-70563
- LASER DRILLING**
- An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- LASER OUTPUTS**
- Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773
- Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers (ESA-TT-1251) p 211 N92-34152
- LASER RANGE FINDERS**
- Innovation in the laser warning sensor field p 89 A92-35742
- Set-up and alignment aspects of a CO2-laser radar for applications in the field (FEL-91-A162) p 158 N92-25378
- Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- LASER WELDING**
- Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773
- Successful transfer of technology from a research and development laboratory to an Aerospatiale production unit p 4 A92-51808
- LASER WINDOWS**
- Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers (ESA-TT-1251) p 211 N92-34152
- LATENT HEAT**
- A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
- LATERAL CONTROL**
- An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
- Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546
- LAUNCH VEHICLES**
- Oriflamm - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles (IAF PAPER 91-207) p 126 A92-14705
- Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies (AIAA PAPER 91-5039) p 94 A92-17827
- Spacecraft structures p 132 A92-33410
- Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645
- The Intospace Market Development Strategy and the scenario of provided microgravity, and launch systems p 279 A92-53777
- Open and closed loop guidance for an airbreathing winged launch vehicle (IAF PAPER 92-0042) p 127 A92-55537
- Plug engine systems for future launch vehicle applications (IAF PAPER 92-0647) p 141 A92-57090
- Safety and mission capabilities of manned launch vehicles (IAF PAPER 92-0383) p 128 A92-57370
- Launcher Propulsion Towards the Year 2010 (ESA-SP-327) p 127 N92-23750
- LAUNCHERS**
- Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471
- Fuzzy guidance system evaluation p 259 N92-27903
- LAUNCHING**
- Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- LAUNCHING BASES**
- Ground operations of a HTOL airbreathing launcher (IAF PAPER 91-217) p 125 A92-14708
- Launch Bases and Control Infrastructures for Spacecraft (ESA-SP-342) p 125 N92-20715
- Esrange: Sounding rocket and balloon facility p 126 N92-20720
- Design evolution of the Ariane launching installations p 126 N92-20726
- Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- LAUNCHING SITES**
- Launch Bases and Control Infrastructures for Spacecraft (ESA-SP-342) p 125 N92-20715
- LEADING EDGE FLAPS**
- Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing (CRANFIELD-AERO-9113-PT-1) p 40 N92-19679
- LEADING EDGE SLATS**
- Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858

LEADING EDGE SWEEP

- Maximum lift of wings with trailing-edge flaps at low speeds
[ESDU-91014] p 28 N92-11970

LEADING EDGES

- Experimental investigation of vortex dynamics on delta wings
[AIAA PAPER 92-2731] p 21 A92-45565
Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter
[FFA-TN-1991-22] p 76 N92-11993
Modeling and numerical simulation of vortex flow in aerodynamics
[AD-B163670L] p 30 N92-12997
Characteristics of a boundary layer in a leading edge vortex
p 31 N92-13012
Numerical simulation of vortex street-edge interaction
p 33 N92-13027
The effect of hoar-frosted wings on the Fokker 50 take-off characteristics
p 56 N92-21692
Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers
[FFA-TN-1991-40] p 43 N92-23168
Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow
[PB92-138718] p 53 N92-70577

LEARNING

- Learning from aircraft accidents and incidents
p 54 A92-39310
Project of an adaptive multi-axial autopilot with learning pilot control
[ETN-92-90592] p 107 N92-15072

LEASING

- Registration of aircraft in the aircraft registrar using the 'Leasing Decree' of the Federal Minister of Transport of February 12, 1991
p 279 A92-11215
Tax aspects of aircraft leasing in the Netherlands
p 280 A92-35588
Conflict of laws in the air - Some legal issues of international aircraft financing and leasing
p 280 A92-35591
Dutch security rights in aircraft and engines
p 280 A92-35594

LEG (ANATOMY)

- Blood lactate during leg exercise in microgravity
p 247 A92-50162

LEGAL LIABILITY

- Registration of aircraft in the aircraft registrar using the 'Leasing Decree' of the Federal Minister of Transport of February 12, 1991
p 279 A92-11215
No end to incidents in airspace? III
p 53 A92-23172
The role of the notary under the laws of the Netherlands - With respect to the transfer of title and encumbrance of registered aircraft
p 280 A92-35595
Convergence of telecommunication technologies - Some legal aspects
p 281 A92-36682
Intellectual Property Rights
[AGARD-LS-181] p 277 N92-18659

LEVITATION

- Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors
p 273 N92-21635

LIAPUNOV FUNCTIONS

- Some problems of the stability of a system of three vortices
p 182 A92-51893

LIFE (DURABILITY)

- The use of load enhancement factors in the certification of composite aircraft structures
[NLR-TP-90068-U] p 86 N92-28649
Damage tolerance and durability evaluation of aluminum-lithium alloys
[PB91-219477] p 150 N92-70307

LIFE CYCLE COSTS

- VSTOL engine design evolution - Growth of the Pegasus engine for Harrier
p 95 A92-45306

LIFE SPAN

- The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study
p 246 A92-34257

LIFE SUPPORT SYSTEMS

- Air purification systems for submarines and their relevance to spacecraft
p 253 N92-25892
Concept for a European Space Station: Habitability, life support, and laboratory facilities
p 254 N92-27023
Moon base habitability aspects
p 254 N92-27026

LIFT

- Optimum cruise lift coefficient in initial design of jet aircraft
p 73 A92-46806
Remarks on the relation between lift induced drag and vortex drag
p 26 A92-53079
On the recovery of the giant fuel tanks of spacecrafts
[IAF PAPER 92-0878] p 128 A92-57266
Lift-curve slope of wing-body combinations
[ESDU-91007] p 28 N92-11968

- Effect of twin fins on isolated tailplane lift-curve slope
[ESDU-91009] p 28 N92-11969

- Maximum lift of wings with trailing-edge flaps at low speeds
[ESDU-91014] p 28 N92-11970

- A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows
[ESDU-91021] p 39 N92-15970

- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution
[ESDU-91029] p 39 N92-15973

- Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment
p 56 N92-21697

- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation
p 45 N92-27944

- Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds
[ESDU-92002-SUPPL] p 51 N92-32782

LIFT DEVICES

- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations
[NLR-TP-89126-U] p 47 N92-28660

LIFT DRAG RATIO

- Effect of a deicing device on the induced drag of a lifting airfoil
p 74 A92-51947

- An aerodynamical analysis of 'seesaw' type rotor for autogyro
p 24 A92-52034

- Hermes nominal reentry trajectories
[IAF PAPER 92-0018] p 124 A92-55516

- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution
[ESDU-91029] p 39 N92-15973

- Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing
[CRANFIELD-AERO-9113-PT-1] p 40 N92-19679

LIFTING BODIES

- Aerodynamic centre of wing-body combinations
[ESDU-92024] p 50 N92-32479

LIFTING ROTORS

- Lifting line predictions for a swept tip rotor blade
p 7 A92-14424

LIGHT EMISSION

- A diffraction limited nitrogen laser for detector calibration in high energy physics
[ETN-92-90567] p 211 N92-17434

LIGHT HELICOPTERS

- P120 programme - First results of the pre-development phase
p 1 A92-14447

- The development of a new light, single engine helicopter family
p 70 A92-35734

LIGHT SCATTERING

- Unsteady three-dimensional Bénard convection - Light-scattering, statistics and chaos
p 168 A92-27379

LIGHT SOURCES

- The acoustic flashlight
[MBB-Z-0359-90-PUB] p 282 N92-15938

LIGHTNING

- Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080

- Lightning strike simulation using coaxial line technique and 3D linear injection current analysis
p 159 A92-20131

- Aircraft lightning strikes
[ONERA, TP NO. 1991-204] p 54 A92-26361

- Mechanisms of high-current pulses in lightning and long-spark stepped leaders
[ONERA, TP NO. 1992-202] p 159 A92-54678

- Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007

LIGHTNING SUPPRESSION

- Whole aircraft lightning indirect effects evaluation using low level injection techniques
p 68 A92-20134

- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft
p 68 A92-20136

LINEAR ARRAYS

- Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method
[ONERA, TP NO. 1991-212] p 13 A92-26364

LINEAR EQUATIONS

- Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD
p 184 A92-56125

LINEAR PROGRAMMING

- A constraint satisfaction approach to operative management of aircraft routing
p 54 A92-25181

LINEAR QUADRATIC REGULATOR

- Control strategies for space systems
p 137 N92-24494

LINEAR SYSTEMS

- Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces
p 105 A92-48496

LINEARIZATION

- A linearised Riemann solver for Godunov-type methods
[CRANFIELD-AERO-9116] p 265 N92-19924

- Global existence for a semilinear elliptic-parabolic PDE system
[REPT-91-70] p 203 N92-30372

LINGUISTICS

- Towards an electronic dictionary of the space technical domain
[IAF PAPER 92-0354] p 277 A92-55764

LIQUID FLOW

- Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate
p 163 A92-16455

LIQUID HELIUM

- Vortex nucleation in rotating superfluid He-3-B
p 271 N92-10476

- Superfluid vortex nucleation in He-3 flow
p 271 N92-10479

- Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256] p 265 N92-23665

- Magnetic suspension using high temperature superconducting cores
p 161 N92-27789

LIQUID NITROGEN

- Magnetic suspension using high temperature superconducting cores
p 161 N92-27789

LIQUID PHASES

- Metal matrix composite fabrication processes for high performance aerospace structures
p 212 A92-42145

LIQUID PROPELLANT ROCKET ENGINES

- Launcher Propulsion Towards the Year 2010
[ESA-SP-327] p 127 N92-23750

LIQUID ROCKET PROPELLANTS

- Bi-propellant thruster family for spacecraft propulsion
[AIAA PAPER 92-3860] p 141 A92-54208

LIQUID SLOSHING

- Numerical investigation of fluid-structure-interaction problems with the finite element method
p 196 N92-23844

- A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft
p 196 N92-23846

- Investigations preparatory to the Wet Satellite Model Experiment
[NLR-TP-91219-U] p 139 N92-32834

LIQUID-LIQUID INTERFACES

- Fractal dimensions and spectra of interfaces with application to turbulence
p 164 A92-20511

LIQUID-SOLID INTERFACES

- Simulation of convective temperature oscillations in phase-change processes
p 169 A92-29523

- Melting and dissolving
p 178 A92-46260

- Numerical investigation of fluid-structure-interaction problems with the finite element method
p 196 N92-23844

LIQUID-VAPOR INTERFACES

- Marangoni convection in V-shaped containers
p 172 A92-37932

LITHIUM ALLOYS

- Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys
[NLR-TP-90172-U] p 220 N92-28850

- New accelerated corrosion test methods
[MBB-Z-0406-91-PUB] p 150 N92-32895

LITHIUM COMPOUNDS

- Integrated heat pipe concept for Li/SOCl₂ cells cooling
p 160 N92-26974

LITHIUM SULFUR BATTERIES

- Integrated heat pipe concept for Li/SOCl₂ cells cooling
p 160 N92-26974

- Performances of 250 Amp-hr lithium/thionyl chloride cells
p 143 N92-27148

LOAD DISTRIBUTION (FORCES)

- Effects of spectrum variations on fatigue crack growth
p 219 A92-57399

- A fatigue analysis of the TF89 tactical fighter aircraft
[ETN-92-90657] p 81 N92-20795

LOAD TESTS

- Fatigue life analysis for variable-amplitude loading
p 218 A92-19697

- The use of load enhancement factors in the certification of composite aircraft structures
[NLR-TP-90068-U] p 86 N92-28649

LOADING MOMENTS

- Short time force measurement system
p 114 N92-15001

LOADS (FORCES)

- On the limitations of Froude's actuator disc concept
[ETN-91-90136] p 29 N92-11973

- Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device
p 78 N92-18583

- Aircraft tracking optimization of parameters selection
p 79 N92-18585
- The Operational Loads Monitoring System, OLMS
p 79 N92-18586
- LOCAL AREA NETWORKS**
The CSMA/CD local area network for hospital services
p 157 N92-15284
- LOGIC PROGRAMMING**
Reasoning with uncertain and incomplete information in aerospace applications
p 261 N92-12544
- LOGISTICS MANAGEMENT**
Flight crew integration in the maintenance chain of a commercial aircraft (A 320)
p 276 N92-30957
- LONG DURATION EXPOSURE FACILITY**
Spacecraft thermal control coatings
p 151 N92-24829
Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11
p 160 N92-27118
Long-term exposure of bacterial spores to space
p 244 N92-27126
LDEF: Dosimetric measurement results (AO 138-7 experiment)
p 271 N92-27231
Oxygen isotopes implanted in the LDEF spacecraft
p 272 N92-27284
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR
p 151 N92-27300
New results from FRECOPA analysis --- long duration exposure facility
p 213 N92-27304
- LONG DURATION SPACE FLIGHT**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity
p 245 A92-15956
- LONG TERM EFFECTS**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity
p 245 A92-15956
- LONGITUDINAL CONTROL**
Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U]
p 109 N92-28652
- LOSSES**
Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades
[ETN-92-92056]
p 205 N92-33910
- LOUDSPEAKERS**
Propeller sound excitation on an aircraft fuselage using a loudspeaker ring
p 72 A92-39087
- LOW ALTITUDE**
Equilibrium configurations in a tethered atmospheric mission
[AAS PAPER 91-543]
p 124 A92-43391
Interest in real-time simulations for the development terrain following function of radar systems
p 158 N92-28529
- LOW ASPECT RATIO**
Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds
[ESDU-91042]
p 84 N92-24009
- LOW COST**
Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine
p 212 A92-50779
- LOW DENSITY WIND TUNNELS**
Compression ramp in rarefied gas
[RC-90-08]
p 29 N92-11978
- LOW FREQUENCIES**
Mechanical noise from large wind turbines - Experiences from Swedish prototypes
p 226 A92-39046
Spacecraft low frequency residual acceleration
[IAF PAPER 92-0970]
p 133 A92-57328
- LOW NOISE**
Noise from turbine generators - Noise control, propagation, and assessment
p 226 A92-39044
- LOW PRESSURE**
Rotational temperature measurements of N₂(+) in an arc jet at low pressure
[AIAA PAPER 92-2967]
p 273 A92-46982
- LOW REYNOLDS NUMBER**
Vorticity measurements in the near wake of a bluff body at low Reynolds numbers
[AERO-REPT-9102]
p 195 N92-22100
- LOW SPEED STABILITY**
Hypersonic configurations in slow speed flight
p 43 N92-24394
- LOW SPEED WIND TUNNELS**
An experiment on unsteady flow over an oscillating airfoil
[ASME PAPER 91-GT-181]
p 8 A92-15613
Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel
[ONERA, TP NO. 1991-219]
p 111 A92-26371
An overview of the planned aerospace test facilities at Capua, Italy
[AIAA PAPER 92-3944]
p 112 A92-56773
- The installation of the AVRO 9 by 7 foot low-speed wind tunnel at the University of Manchester (England)
[AERO-REPT-9005]
p 114 N92-18341
Characterization of unsteady aerodynamic phenomena at high angles
p 80 N92-18787
- LUMINAIRES**
Examination of aircraft warning and caution lights after shock testing
[NLR-TP-89284-U]
p 58 N92-30474
- LUNAR BASES**
The Space Exploration Initiative and the Aero-Space Plane Launcher
p 120 A92-39510
Moon base habitability aspects
p 254 N92-27026
- LUNAR EXPLORATION**
Solar sail expedition to the moon and Mars - Mission update
p 121 A92-53430
- LYMPHOCYTES**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity
p 245 A92-15956
Changes observed in lymphocyte behavior during gravitational unloading
p 247 A92-52395
- M**
- MACH NUMBER**
Large chord turbine cascade testing at engine Mach and Reynolds number
p 10 A92-18771
A note on the Kutta condition in Glauert's solution of the thin aerofoil problem
p 16 A92-37933
Concorde flight testing - Powerplant and performance flying
[SAE PAPER 912192]
p 72 A92-40009
Propulsion system performance and integration for high Mach air breathing flight
p 96 A92-46429
Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method
p 105 A92-47779
Blade design and analysis using a modified Euler solver
p 97 N92-13952
Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers
p 35 N92-14991
A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows
[ESDU-91021]
p 39 N92-15970
Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements
[ETN-92-91492]
p 49 N92-29889
Numerical simulation of turbulence at the back of the airplane
[ETN-92-91664]
p 51 N92-32769
- MACHINERY**
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations
p 213 N92-14360
- MACHINING**
Optical micromachined pressure sensor for aerospace applications
p 208 A92-52370
- MAGNETIC BEARINGS**
Control concepts for active magnetic bearings
p 214 N92-27743
- MAGNETIC CONTROL**
A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft
[IAF PAPER 92-0031]
p 132 A92-55527
Spacecraft attitude control using magnetic torquers and gas jets
p 137 N92-24496
- MAGNETIC FIELD RECONNECTION**
A family of two-dimensional nonlinear solutions for magnetic field annihilation
p 272 A92-33574
Traveling magnetospheric convection twin-vortices - Observations and theory
p 232 A92-55089
- MAGNETIC FIELDS**
Dynamics of vortices in high-temperature superconductors
p 273 N92-10501
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors
p 273 N92-21635
Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
[PB92-142421]
p 273 N92-22738
Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256]
p 265 N92-23665
Spacecraft attitude control using magnetic torquers and gas jets
p 137 N92-24496
Viscous and Joule heating effects on MHD free convection flow with variable plate temperature
[DE91-633612]
p 273 N92-70166
- MAGNETIC FLUX**
Interaction between moving flux lines and a two-dimensional electron gas
p 273 A92-11897
Neutron superfluid spin-down and magnetic field decay in pulsars
p 283 A92-13865
- Dynamics of vortices in high-temperature superconductors
p 273 N92-10501
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors
p 273 N92-21635
- MAGNETIC STARS**
Modelling stellar surface magnetic fields. I - Search strategies and uniqueness
p 283 A92-14147
- MAGNETIC SUSPENSION**
Magnetic suspension using high temperature superconducting cores
p 161 N92-27789
Wind tunnel magnetic Suspension Systems at the University of Southampton, England
p 115 N92-27804
- MAGNETIZATION**
Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
[PB92-142421]
p 273 N92-22738
- MAGNETOHYDRODYNAMIC FLOW**
Spherically symmetric, polytropic flow
p 284 A92-20810
A family of two-dimensional nonlinear solutions for magnetic field annihilation
p 272 A92-33574
Model of anomalous transport with backreacting localized perturbations
p 265 A92-47422
Viscous and Joule heating effects on MHD free convection flow with variable plate temperature
[DE91-633612]
p 273 N92-70166
- MAGNETOMETERS**
Dual technique magnetometer experiment for the Cassini Orbiter spacecraft
p 139 A92-53412
- MAGNETOPAUSE**
Traveling magnetospheric convection twin-vortices - Observations and theory
p 232 A92-55089
- MAGNETOPLASMA DYNAMICS**
Plasma thruster development program at the IRS
[IAF PAPER 92-0610]
p 141 A92-57061
- MAGNETOSHEATH**
Signatures of transient boundary layer processes observed with Viking
p 230 A92-24532
- MAGNETOSPHERE-IONOSPHERE COUPLING**
Measurement of field-aligned currents by the SABRE coherent scatter radar
p 231 A92-31271
- MAINTAINABILITY**
Reliability, availability, maintainability, and safety
p 216 N92-18639
A product assurance engineering concept for complex space systems
p 216 N92-18645
RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems
p 258 N92-18647
Specifying PA/safety design to requirements for the Columbus project and general conclusions
p 153 N92-18649
- MAINTENANCE**
Expert systems for the trouble-shooting and the diagnostics of engines
[AIAA PAPER 92-3327]
p 260 A92-48910
Repair procedures for advanced composites for helicopters
p 4 A92-56277
Repair procedures for advanced composites for helicopters
[MBB-UD-0606-91-PUB]
p 5 N92-29874
Maintainability requirements for ESA space systems
[ESA-PSS-01-50-ISSUE-1]
p 217 N92-29878
Ageing airplane repair assessment program for Airbus A300
p 57 N92-30123
- MALFUNCTIONS**
Reducing risks
p 278 A92-22725
- MAN MACHINE SYSTEMS**
Utilization of a research simulator for the development of new flight control concepts
[ONERA, TP NO. 1991-161]
p 110 A92-16128
Design principles of automation aids for ATC approach control
p 62 N92-19042
The role of simulation for the study of APIS (piloting support by synthetic imagery)
p 116 N92-28544
NARSIM: A real-time simulator for air traffic control research
[NLR-TP-90147-U]
p 117 N92-29204
- MAN TENDED FREE FLYERS**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer
[IAF PAPER 91-105]
p 119 A92-12508
Hermes-space station phasing strategies optimization
[IAF PAPER 91-345]
p 130 A92-14751
- MAN-COMPUTER INTERFACE**
A conceptualization of aviation psychology on the civil flight deck
p 250 A92-13849
Concept for future cockpits
p 88 A92-16148
Integrating machine intelligence into the cockpit to aid the pilot
p 252 N92-12533
Interactive visualization of CFD results ASCETE
p 190 N92-16235

- FLOVIS (FLOw VISualizer) user manual, release 2.6, September 1990 p 190 N92-18238
- The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041
- COMPAS system concept p 63 N92-19043
- Evaluation of the COMPAS experimental system p 63 N92-19044
- Steps toward acceptance p 63 N92-19046
- Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905
- MANAGEMENT ANALYSIS**
- Behind the screens --- development of Central Flow Management Unit for air traffic control p 59 A92-25520
- MANAGEMENT METHODS**
- Aircraft fatigue management in the Royal Air Force p 79 N92-18591
- Organisational robustness for manned space flight p 152 N92-18618
- MANAGEMENT PLANNING**
- National user interfaces p 224 N92-23407
- MANAGEMENT SYSTEMS**
- Transition to cooperative ATM system requires commitment --- Air Traffic Management p 59 A92-23297
- Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322
- Proposal for the new fatigue management system for the AMX p 78 N92-18580
- Criticality management in space programs p 275 N92-18619
- Safety risk management for ESA space systems p 153 N92-18635
- Implementation of the total quality management concept within space business p 275 N92-18640
- Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661
- The role of planning systems in future air traffic management p 64 N92-19050
- Software management strategies and practices for space systems development p 258 N92-20610
- Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
- MANEUVERABILITY**
- Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
- Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870
- MANEUVERABLE REENTRY BODIES**
- Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
- MANIPULATORS**
- Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704
- Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313
- Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
- MANNED MARS MISSIONS**
- The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510
- Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- MANNED REENTRY**
- Compression ramp in rarefied gas [RC-90-08] p 29 N92-11978
- MANNED SPACE FLIGHT**
- Organisational robustness for manned space flight p 152 N92-18618
- Why quantify risk? p 153 N92-18637
- Astronautics 1977-1990 [AERONOMICA-ACTA-F-42-1991] p 287 N92-30996
- MANNED SPACECRAFT**
- Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- The space environment and its effects on spacecraft design p 120 A92-33403
- Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
- ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
- Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892
- MANUAL CONTROL**
- A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
- MANUFACTURING**
- 36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
- High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 N92-20911
- Keys to excellence in design and manufacture [PNR-90781] p 276 N92-20927
- A manufacturer's approach to ensure long term structural integrity p 57 N92-30133
- Flutter models: Their design, manufacture, and ground testing p 109 N92-34164
- MAPPING**
- Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
- Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691
- MARANGONI CONVECTION**
- Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
- Marangoni convection in V-shaped containers p 172 A92-37932
- MARINE METEOROLOGY**
- Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- MARINE PROPULSION**
- Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993
- MARITIME SATELLITES**
- Implementation of Inmarsat mobile satcom systems p 157 N92-24073
- MARKET RESEARCH**
- Aircraft financing in Spain p 280 A92-35593
- Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076
- MARKETING**
- The Intospace Market Development Strategy and the scenario of provided microgravity, and launch systems p 279 A92-53777
- Market directed thinking in a technological operation p 276 N92-23929
- MARS LANDING**
- Aerostat for the Mars 1994/1996 mission p 285 N92-24642
- MASS TRANSFER**
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- MASSIVELY PARALLEL PROCESSORS**
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow [ONERA, TP NO. 1991-196] p 255 A92-26355
- MATERIALS TESTS**
- Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990 [ISBN 0-85498-530-1] p 144 A92-45335
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048
- Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307
- MATHEMATICAL MODELS**
- Simulation of hypersonic flows on unstructured grids p 15 A92-31496
- A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
- Selected models of aircraft navigation space p 61 A92-45373
- Aircraft stabilization at large angles of attack p 105 A92-47785
- Dynamics of vortices in high-temperature superconductors p 273 N92-10501
- Airframe noise p 268 N92-10605
- Rotorcraft system identification [AGARD-AR-280] p 75 N92-11001
- On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973
- Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386
- Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997
- Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
- A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium p 187 N92-14325
- Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 N92-14326
- Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014
- Influence of chemical modelling on hypersonic flow p 37 N92-15015
- The dynamic response of separated hypersonic flows p 38 N92-15019
- Physical and computational modelling of stratified shear flows [AERO-REPT-8909] p 190 N92-17974
- A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
- Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089
- Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235
- On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319
- Aircraft aerodynamics and stability and control during air-to-air refueling [AERO-REPT-9017] p 107 N92-18321
- Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 N92-18340
- Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- Circulatory biomechanics effects of accelerations p 248 N92-18991
- Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
- Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 N92-19292
- Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-90867] p 192 N92-19349
- Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDiF [NLR-TR-88108-U] p 64 N92-19491
- Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
- A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
- Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 N92-21788
- A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271
- Vortex lattice-vortex liquid states in anisotropic high-T sub c) superconductors [PB92-142421] p 273 N92-22738
- Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168

- The structural optimization system OPTSYS: Current status and applications p 83 N92-23232
- Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 N92-23238
- Structural optimization of aircraft practice and trends p 83 N92-23239
- Ultrasonic investigation of (3)He-A vortices in low magnetic fields [PB92-142256] p 265 N92-23665
- Gravity field data products from the Aristoteles mission p 224 N92-23925
- Computational procedures for preliminary design p 84 N92-23952
- Panel methods for aerodynamic analysis and design p 84 N92-23955
- Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 N92-23974
- Boundary Layers in Turbomachines [VKI-LS-1991-06] p 99 N92-24336
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 N92-24343
- Determination of the structural weight of spacecraft p 135 N92-24387
- Modeling and simulation of complex mechanical systems for space applications p 135 N92-24389
- A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881
- Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 N92-25959
- Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
- Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
- Investigation of convection over sea by aircraft observations p 225 N92-26337
- The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 N92-27062
- The coherent flamelet model for propulsion applications p 147 N92-27486
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
- Finite element methods for flow problems p 200 N92-27672
- Multidimensional upwind methods for unstructured grids p 201 N92-27675
- Unstructured grid methods for compressible flows p 201 N92-27676
- Basic concepts on boundary layers p 44 N92-27707
- Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
- Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
- Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201
- A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741
- A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 N92-29972
- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
- Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB/FE211/S/PUB/466] p 204 N92-30674
- Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 N92-31942
- Modelling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
- Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 N92-32725
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767
- CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 N92-32835
- Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952
- SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249
- MATHEMATICAL PROGRAMMING**
- The structural optimization system OPTSYS: Current status and applications p 83 N92-23232
- Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474
- MATRICES (MATHEMATICS)**
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- MATRIX MATERIALS**
- The search for new materials [PNR-90777] p 145 N92-21744
- MAXWELL EQUATION**
- Lightning strike simulation using coaxial line technique and 3D linear injection current analysis p 159 A92-20131
- Finite element simulation of viscoelastic flow p 205 N92-34038
- MEASUREMENT**
- Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336
- MEASURING INSTRUMENTS**
- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 N92-12203
- Model incidence measurement using SAAB ELOPTOPUS system [NLR-TP-89182-U] p 115 N92-18416
- The basic measuring technical equipment of the DLR test aircraft p 92 N92-25592
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870
- MECHANICAL DEVICES**
- A managerial approach for reliability verification of mechanical equipment [MBB-UK-0140-PUB] p 275 N92-18634
- Modeling and simulation of complex mechanical systems for space applications p 135 N92-24389
- MECHANICAL ENGINEERING**
- Repair procedures for advanced composites for helicopters p 4 A92-56277
- Compressing the compressor [PNR-90824] p 99 N92-21848
- Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
- The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666
- The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853
- Repair procedures for advanced composites for helicopters [MBB-UD-0606-91-PUB] p 5 N92-29874
- MECHANICAL MEASUREMENT**
- Short time force measurement system p 114 N92-15001
- MECHANICAL PROPERTIES**
- Aerospace Arall - A challenge for the aircraft designer p 143 A92-10232
- The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760
- Introduction to metal matrix composites and a review of their potential uses p 144 A92-45336
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
- Modeling and computation of composite materials [ONERA, TP NO. 1992-50] p 144 A92-48611
- Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- Hot melt joints for carbon fibre reinforced composites p 213 A92-54870
- A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 N92-17434
- Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 N92-28850
- Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- MECHANICAL SHOCK**
- Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382
- MEDICAL EQUIPMENT**
- The CSMA/CD local area network for hospital services p 157 N92-15284
- MEDITERRANEAN SEA**
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- MELTING**
- Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- Melting and dissolving p 178 A92-46260
- MEMORY (COMPUTERS)**
- Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473
- MENTAL HEALTH**
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 N92-13547
- MENTAL PERFORMANCE**
- Knowledge transfer and anticipation in airline piloting p 250 A92-45065
- The role of planning systems in future air traffic management p 64 N92-19050
- MERIDIONAL FLOW**
- Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
- MESH**
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
- MESOPAUSE**
- Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800
- MESOSCALE PHENOMENA**
- Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902
- On the relation between total ozone and meteorology p 236 A92-27796
- A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489
- Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988 [AD-A246775] p 243 N92-28365
- MESSAGE PROCESSING**
- Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 N92-12156
- METABOLISM**
- Gravity effects on reproduction, development, and aging p 244 A92-34193
- METAL FATIGUE**
- Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
- High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- METAL MATRIX COMPOSITES**
- Hypersonic materials p 143 A92-18002
- The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145
- Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990 [ISBN 0-85498-530-1] p 144 A92-45335
- Introduction to metal matrix composites and a review of their potential uses p 144 A92-45336
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982
- METAL PLATES**
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
- METAL SHEETS**
- Cost effective solutions for titanium sheet metal forming p 211 A92-22785

A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026

METALS

Joining of composite materials to metals p 211 A92-10695

METEOR TRAILS

On the radiant determination of meteors p 283 A92-18593

METEOROID PROTECTION

Protection of spacecraft against meteoroid/orbital debris impacts p 134 A92-23786

METEOROLOGICAL FLIGHT

Commission for Aeronautical Meteorology. Abridged final report of the ninth session [WMO-752] p 240 A92-18911

METEOROLOGICAL INSTRUMENTS

Use of relative humidity sensors for planes measurement p 89 A92-32080
The DLR meteorological research aircraft Falcon p 240 A92-26348

METEOROLOGICAL PARAMETERS

Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 A92-19292

METEOROLOGICAL RADAR

Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291
Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 A92-29326

METEOROLOGICAL SERVICES

The new airport aeronautical meteorological codes p 235 A92-13855
Shear progress --- wind shear handling and recognition technologies for aviation p 3 A92-40880
Commission for Aeronautical Meteorology. Abridged final report of the ninth session [WMO-752] p 240 A92-18911

METEOROLOGY

On the relation between total ozone and meteorology p 236 A92-27796
European industrial capabilities to provide meteorological space systems p 228 A92-25238
Space electronic display panel p 278 A92-25787
Remote sensing of atmosphere with aircraft borne lidar systems p 234 A92-26347
Airborne lidar and radiometric observations of PBL and low clouds p 240 A92-31037

METEOSAT SATELLITE

European industrial capabilities to provide meteorological space systems p 228 A92-25238

METHOD OF CHARACTERISTICS

Quasi-three-dimensional characteristics method for a supersonic compressor rotor [ASME PAPER 91-GT-81] p 7 A92-15549
Extended mapping and characteristics techniques for inverse aerodynamic design p 76 A92-13949

MICROBALLOONS

Modelling compressible turbulent mixing p 178 A92-45094

MICROBURSTS (METEOROLOGY)

Lightning activity in microburst producing storm cells [ONERA, TP NO. 1991-98] p 235 A92-16080

MICROGRAVITY APPLICATIONS

Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
High performance capillary electrophoresis in microgravity environment p 206 A92-20996

MICROMETEORITES

Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 A92-20477

MICROMETEOROLOGY

A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268

MICROPHONES

The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 A92-15938

MICROSTRUCTURE

The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 A92-20911

MICROWAVE COUPLING

Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315

MICROWAVE EQUIPMENT

Recommended system concept p 224 A92-23383

MICROWAVE IMAGERY

Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 A92-29877

MICROWAVE LANDING SYSTEMS

Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
DME growth elements and their use with MLS p 62 A92-14018
Development of new flight procedures for the Microwave Landing System (MLS) [NLR-TP-91156-U] p 66 A92-32830

MICROWAVE RADIOMETERS

Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302

MICROWAVE SOUNDING

Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034

MIDAIR COLLISIONS

UK airmisses involving commercial air transport: September - December 1990 [ETN-92-91050] p 56 A92-21746

MIDDLE ATMOSPHERE

The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model --- of trace elements in middle atmosphere p 239 A92-53349
Tracer transport in the middle atmosphere p 229 A92-26473

MIG AIRCRAFT

Rapidly going nowhere? --- combat aircraft development in Russia p 74 A92-54545

MILITARY AIRCRAFT

A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345
Clever cockpits p 1 A92-21700
The other missiles p 2 A92-28184
Noise from military airfields in the United Kingdom p 226 A92-39052

Rafale: Program update - Development of a naval version p 72 A92-40035
International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings [ISBN 0-903409-68-2] p 3 A92-45302
The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 A92-33033

MILITARY AVIATION

Anglo-American avionics p 2 A92-25575
Military and civil software standards and guidelines for guidance and control p 257 A92-12452

MILITARY HELICOPTERS

Requirements and possible technical solutions derived from the new air mobility concept of the German Army p 1 A92-14348
P120 programme - First results of the pre-development phase p 1 A92-14447
The other missiles p 2 A92-28184
Rapidly going nowhere? --- combat aircraft development in Russia p 74 A92-54545
Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
Lynx - A 50 year product? p 75 A92-56307
AS 332 MKII - Development and certification p 75 A92-56343

EH 101 ship interface trials: Flight test programme and preliminary results p 82 A92-21964
United Kingdom approach to deriving military ship helicopter operating limits p 82 A92-21966

MILITARY OPERATIONS

Approach and landing guidance p 65 A92-21960
United Kingdom approach to deriving military ship helicopter operating limits p 82 A92-21966
Opportunities for flight simulation to improve operational effectiveness p 115 A92-28523

MILITARY TECHNOLOGY

Clever cockpits p 1 A92-21700
Anglo-American avionics p 2 A92-25575
The design challenge of a long endurance airship [AIAA PAPER 92-1266] p 69 A92-33344
Software methodologies for safety critical systems p 257 A92-12467

MILLIMETER WAVES

The near millimetre wavelength optical constants of calcium lanthanum sulphide --- for IR window applications in high-speed aircraft p 272 A92-52965
Millimeter wave technology in space p 283 A92-25782

MIMD (COMPUTERS)

Architecture and interconnects of programmable processors of radar signals p 159 A92-23042

MINIMAX TECHNIQUE

Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 A92-12156

MINIMUM DRAG

Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 A92-28660

MINKOWSKI SPACE

Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 A92-21788

MIR SPACE STATION

Soviet space at the crossroads p 118 A92-11881
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 A92-27300

MIRAGE AIRCRAFT

Mirage 2000-5 - Dassault's delta described p 67 A92-16622
Aircraft tracking optimization of parameters selection p 79 A92-18585

Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 A92-21970

MISSILE BODIES

Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
Vortex flow on a missile body: Experimental study and modeling p 32 A92-13013

MISSILE CONFIGURATIONS

Dynamic wind tunnel tests on control of forebody vortices with suction p 107 A92-18793

MISSILE DESIGN

The ASMP program p 3 A92-41823

MISSILE STRUCTURES

Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392

MISSILES

Lift-curve slope of wing-body combinations [ESDU-91007] p 28 A92-11968
Vortex flow on a missile body: Experimental study and modeling p 32 A92-13013
Optimal guidance anticipating missile performance p 128 A92-27902

MISSION PLANNING

Operational aspects of spacecraft autonomy p 131 A92-24207
USO concept in the member states - The Netherlands p 120 A92-32467
Generalities on the ramjet p 95 A92-41819
Spectacular return for Columbia - Oldest Shuttle to make 13-day science mission p 128 A92-43596
Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842

Development of tactical decision aids p 90 A92-12532

Integrating machine intelligence into the cockpit to aid the pilot p 252 A92-12533
Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 A92-23975

Spacecraft Flight Dynamics [ESA-SP-326] p 122 A92-24719

Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 A92-27887

Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 A92-27888

Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 A92-29879

Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 A92-32229

MIXED OXIDES

Observation of inverse domains in high Tc superconductors p 273 A92-52211

MIXING

The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 A92-18933

MIXING LAYERS (FLUIDS)

Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221

Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451

The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143

Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144

Adaptive spectral methods with application to mixing layer computations p 182 A92-52404

Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 A92-14328

Continuous wavelet analysis of coherent structures p 203 A92-30673

MIXING LENGTH FLOW THEORY

Turbulence modelling for secondary flow prediction in a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535

Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093

Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 A92-27457

The application of a Navier-Stokes CFD method to civil engine intake flows p 199 A92-27471

Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects [NLR-TP-90184-U] p 201 A92-28694

MOBILE COMMUNICATION SYSTEMS

The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system p 58 A92-13851

The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852

Implementation of Inmarsat mobile satcom systems p 157 A92-24073

Inmarsat aeronautical mobile satellite system: Internetworking issues p 158 A92-24098

MODAL RESPONSE

Dynamic characterization and identification of nonlinear systems application to aeronautical structures p 217 A92-11830

Advances in aircraft modal identification [ONERA, TP NO. 1992-47] p 105 A92-48608

Elasto-acoustic damped vibrations - Finite element and modal reduction methods p 218 A92-48613

Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 A92-23844

The dynamics of the Cluster spacecraft p 137 A92-24510

MODEL REFERENCE ADAPTIVE CONTROL

A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527

MODELS

Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 A92-26974

MODES

Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 A92-24504

MODULARITY

Avionics standardization in Europe p 91 A92-14050

Recommended system concept p 224 A92-23383

MODULES

Mixed approach towards modular avionics conflicting requirements p 91 A92-14051

MOISTURE CONTENT

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 A92-26349

MOLECULAR FLOW

Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722

Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet p 183 A92-52794

MOLECULAR GASES

Fluid dynamic forces on tethered satellite systems p 124 A92-52738

MOMENT DISTRIBUTION

Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 A92-27944

MOMENTS OF INERTIA

Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia --- aircraft models applied to real aircraft p 217 A92-12346

Dynamics of spacecraft p 123 A92-33404

MOMENTUM

A theoretical test of the geostrophic momentum approximation p 237 A92-39471

The stratospheric residual circulation as deduced from satellite data p 232 A92-14498

MONITORS

The Operational Loads Monitoring System, OLMS p 79 A92-18586

Airborne lidar and radiometric observations of PBL- and low clouds p 240 A92-31037

MONOPULSE RADAR

Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299

Monopulse secondary surveillance radar and the mode-S surveillance system p 62 A92-53239

MONOTONE FUNCTIONS

Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations [ONERA, TP NO. 1991-131] p 9 A92-16107

MONTE CARLO METHOD

Computation of aircraft geometric height under radar surveillance p 61 A92-40239

Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261

Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876

Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770

Efficient computation of particle movement in 3-D DSMC calculations on structured body-fitted grids p 256 A92-52771

Compression ramp in rarefied gas [RC-90-08] p 29 A92-11978

Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 A92-11979

Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 A92-15033

Transitional flows around re-entry bodies p 38 A92-15035

Computation of thermal radiation on spacecraft with mobile parts p 259 A92-25848

MORTALITY

The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257

MOTION PICTURES

Visualization of instationary flows by particle traces p 189 A92-16234

MOTION SICKNESS

Critical technologies: Spacecraft habitability, an update p 254 A92-27010

MOTION SICKNESS DRUGS

Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703

MOTION SIMULATION

The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 A92-28579

MOVING TARGET INDICATORS

Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293

MRCIA AIRCRAFT

Expert system for the Tornado ground-based check-out system p 91 A92-12536

Aircraft fatigue management in the Royal Air Force p 79 A92-18591

Tornado structural fatigue life assessment of the German Air Force p 79 A92-18592

Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 A92-27888

The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 A92-28539

Airborne experimental FLIR program p 93 A92-32447

MULTIBEAM ANTENNAS

Italsat spacecraft multibeam payload antenna closed loop fine pointing system [IAF PAPER 91-509] p 129 A92-18519

MULTIGRID METHODS

Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation [ONERA, TP NO. 1991-235] p 168 A92-26386

Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034

A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665

A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617

Patch-independent structured multiblock grids for CFD computations p 263 A92-47078

Multigrid grid generation in scalar and parallel environments p 256 A92-47084

Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090

Unstructured multigriding by volume agglomeration - Current status p 179 A92-47157

A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 A92-14321

Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 A92-14989

A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 A92-15026

Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 A92-23251

Cell vertex methods for compressible gas flows p 197 A92-26599

Computational techniques for solving the Navier-Stokes equations p 198 A92-27451

A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 A92-30454

New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 A92-32730

MULTIPHASE FLOW

A PC-based inverse design method for radial and mixed flow turbomachinery p 97 A92-13943

On the determination of turbulent mixing coefficients from Eulerian current data p 195 A92-22121

MULTIPLE ACCESS

The CSMA/CD local area network for hospital services p 157 A92-15284

MULTIPROCESSING (COMPUTERS)

Status and user characterization of parallel machines for digital simulation p 260 A92-23046

Parallel processing applications for gas turbine engine control p 96 A92-11012

MULTISENSOR APPLICATIONS

An integrated navigation system manager using federated Kalman filtering p 90 A92-48477

Reasoning with uncertain and incomplete information in aerospace applications p 261 A92-12544

Introduction: Ocean air observation p 224 A92-23381

Recommended system concept p 224 A92-23383

Seaborne lidar system p 224 A92-23389

National user interfaces p 224 A92-23407

MULTISPECTRAL BAND SCANNERS

Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104

TIMS calibration correction by comparison with PRT5 p 223 A92-11412

CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 A92-29707

MULTISPECTRAL RADAR

Recommended system concept p 224 A92-23383

MUON SPIN ROTATION

Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors p 273 A92-21635

MUSCULOSKELETAL SYSTEM

Rib cage shape and motion in microgravity p 247 A92-56944

MUSEUMS

Air museum p 283 A92-25761

N

NACELLES

The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848

NASA PROGRAMS

The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing p 223 A92-44167

NASTRAN

Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218

NAVIER-STOKES EQUATION

Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483

- Turbine cascade calculations through a fractional step Navier-Stokes algorithm p 7 A92-15533
[ASME PAPER 91-GT-55]
- Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis p 93 A92-15625
[ASME PAPER 91-GT-203]
- Transonic cascade flow prediction using the Navier-Stokes equations p 8 A92-15690
[ASME PAPER 91-GT-313]
- Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations p 9 A92-16107
[ONERA, TP NO. 1991-131]
- Asymptotic techniques for the analysis of fluid systems p 163 A92-16229
- Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
- An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
- Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil p 11 A92-22149
[AIAA PAPER 92-0027]
- An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256
- Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289
- Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model p 11 A92-23803
[AIAA PAPER 92-0195]
- Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- On the numerical treatment of nonlinear source terms in reaction-convection equations p 168 A92-26269
[AIAA PAPER 92-0419]
- Validation of a 3D Navier-Stokes code on experimental compressor bladings p 13 A92-26381
[ONERA, TP NO. 1991-229]
- Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes p 13 A92-26387
[ONERA, TP NO. 1991-237]
- Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
- Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
- Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
- A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
- Well-posedness in the generalized sense for the incompressible Navier-Stokes equation p 262 A92-37789
- Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- Extrapolation procedures for the time-dependent Navier-Stokes equations p 19 A92-41289
- On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
- Turbulence - The filtering approach p 175 A92-41656
- Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
- A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617
- Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions p 20 A92-45507
[AIAA PAPER 92-2638]
- Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704
- Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
- Numerical and experimental investigation of rarefied compression corner flow p 23 A92-47876
[AIAA PAPER 92-2900]
- Navier-Stokes computation over a three-dimensional ramp p 181 A92-48616
[ONERA, TP NO. 1992-55]
- Numerical computations of transonic flows through cascades p 24 A92-48702
[AIAA PAPER 92-3041]
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
- On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124
- An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
- Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
- Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile p 185 A92-11307
[CERT-RT-65/5604-35]
- Resolution of Navier-Stokes equations around profiles: Drag evolution p 186 A92-11310
[ONERA-RTS-86/1685-AY-156A]
- Compression ramp in rarefied gas p 29 A92-11978
[RC-90-08]
- Flat planes in rarefied hypersonic flows p 29 A92-11979
[SESSIA-430/91-940]
- Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing p 30 A92-12998
[AD-B163639L]
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 A92-13003
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 A92-13018
- Numerical simulation of vortex street-edge interaction p 33 A92-13027
- A boundary integral approach in primitive variables for free surface flows p 187 A92-14304
- A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates p 187 A92-14321
[REPT-91-12]
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) p 188 A92-14328
[VKI-TN-176]
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 A92-14977
- Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 A92-14981
- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 A92-14990
- SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 A92-14999
- Verification and application of the NSFLEX method for hypersonic flow conditions p 36 A92-15005
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006
- Efficient solution of three-dimensional viscous hypersonic flows p 37 A92-15007
- Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 A92-15008
- A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 A92-15026
- Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 A92-15030
- Parallel and vector aspects of a multigrid Navier-Stokes solver p 260 A92-16645
[PB91-232868]
- Comparison of two solution methods for the numerical calculation of hypersonic flows p 39 A92-17311
[MBB-FE211-S-PUB-446]
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 A92-17853
- Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow p 40 A92-18231
[AERO-REPT-9007]
- Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate p 40 A92-18232
[AERO-REPT-9008]
- Modelling of interfacial and thermocline waves p 243 A92-18234
[AERO-REPT-9011]
- Computation of laminar flow over cavities p 191 A92-18235
[AERO-REPT-9013]
- Use of CFD in the design of a modern multistage aero engine LP turbine design p 98 A92-20179
[PNR-90862]
- Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows p 42 A92-22179
[MBB-FE211-S-PUB-449]
- Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 A92-22180
- Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 A92-22181
- Case 7.4 delta wing: Navier-Stokes calculation p 42 A92-22182
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 A92-22270
- Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 A92-24963
- Computational techniques for solving the Navier-Stokes equations p 198 A92-27451
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 A92-27457
- The application of a Navier-Stokes CFD method to civil engine intake flows p 199 A92-27471
- Three dimensional flow in sharp bends --- ducted flow p 200 A92-27481
- The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 A92-27482
- Flow computation in combustion chambers using zonal nonstaggered grids p 200 A92-27483
- Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 A92-27948
- Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 A92-29977
- A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates p 203 A92-30454
[REPT-91-73]
- Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations p 51 A92-32773
[ONERA-RSF-24/1408-AY-150A]
- CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 A92-32835
- NAVIGATION**
- Airborne experimental FLIR program p 93 A92-32447
- NAVIGATION AIDS**
- The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
- An integrated navigation system manager using federated Kalman filtering p 90 A92-48477
- Flight management system back-up navigation for the A330/A340 aircraft p 106 A92-49326
- Future developments in aeronautical satellite communications p 158 A92-24167
- NAVSTAR SATELLITES**
- Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
- Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928
- NAVY**
- US Navy revisits escape modules p 73 A92-47975
- NEAR WAKES**
- Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- NETHERLANDS**
- Review of aerodynamic design in the Netherlands p 76 A92-13929
- NETHERLANDS SPACE PROGRAM**
- USO concept in the member states - The Netherlands p 120 A92-32467
- NEUROLOGY**
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 A92-13547
- NEUROPSYCHIATRY**
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 A92-13547
- NEUTRON SCATTERING**
- A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- NEUTRON STARS**
- Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146
- NEWTON METHODS**
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 A92-27945
- NICKEL**
- Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 A92-27118

NICKEL ALLOYS

- High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
- Corrosion damage and regeneration of aluminate coatings on aircraft turbine blades p 148 A92-15244
- High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
- Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867

NIGHT

- The concept of a long duration stratospheric balloon p 43 A92-24645

NIGHT FLIGHTS (AIRCRAFT)

- Integrated helmet system testing for a nightflying helicopter p 90 A92-56291

NIGHT VISION

- Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
- Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 A92-19008
- Fixed wing night attack EO integration and sensor fusion p 253 A92-19009

NITROGEN LASERS

- A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 A92-17434

NITROGEN OXIDES

- Environmental impact of a future supersonic transport aircraft [ONERA, TP NO. 1991-132] p 226 A92-16108
- Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 A92-21740

NITROGEN PLASMA

- Rotational temperature measurements of N₂(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982

NOISE (SOUND)

- Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction [ONERA-RS-97/5094-PY] p 269 A92-21736

NOISE GENERATORS

- Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 A92-29201

NOISE INTENSITY

- A survey of active control in aircraft cabins p 72 A92-39084
- Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 A92-32961

NOISE MEASUREMENT

- Mechanical noise from large wind turbines - Experiences from Swedish prototypes p 226 A92-39046
- Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- Do we really need 57 ways of rating aircraft noise? p 227 A92-39065
- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 A92-32956
- Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 A92-32960
- Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 A92-32961

NOISE POLLUTION

- Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044
- NATO CCMS aircraft noise study on receiver technology p 226 A92-39050
- Noise from military airfields in the United Kingdom p 226 A92-39052
- Do we really need 57 ways of rating aircraft noise? p 227 A92-39065
- The environmental challenges for the next supersonic aircraft [PNR-90782] p 228 A92-20928
- Environmentally sound [PNR-90776] p 228 A92-21743

NOISE PREDICTION

- Calculation of noise generated in flows on the basis of an aerodynamic/acoustic decomposition p 267 A92-48596
- [ONERA, TP NO. 1992-35] p 267 A92-48596
- Prediction of far-field harmonic noise from propellers [ESDU-91033] p 269 A92-18074

NOISE PREDICTION (AIRCRAFT)

- Acoustic isolation of layers p 265 A92-12345

Theoretical study and prediction of BVI noise including close interactions

- [ONERA, TP NO. 1991-174] p 265 A92-16138
- NASA's quiet side. I p 3 A92-37875
- Noise from military airfields in the United Kingdom p 226 A92-39052

DANSIM applications - Development of airport noise reduction strategies and environmental policy

- p 227 A92-39057
- Advanced method for single event aircraft noise analysis p 266 A92-39060

Propeller aircraft interior noise - Physical background and possible treatments

- p 71 A92-39082
- Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087
- Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
- Jet aircraft noise at high subsonic flight Mach numbers p 270 A92-29997

[DLR-FB-91-28] p 270 A92-29997**Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 A92-32952****Advanced Study for Active Noise Control in Aircraft (ASANCA) p 270 A92-32956****[AIAA PAPER 92-2092] p 270 A92-32956****NOISE PROPAGATION****Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 A92-39064****Study of noise generated by the impingement of a hot supersonic jet on an obstacle p 267 A92-48594****[ONERA, TP NO. 1992-33] p 267 A92-48594****NOISE REDUCTION****Acoustic isolation of layers p 265 A92-12345****Combat aircraft jet engine noise studies p 266 A92-26353****[ONERA, TP NO. 1991-192] p 266 A92-26353****Generalized higher harmonic control - Ten years of Aerospace experience p 104 A92-35769****Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044****NATO CCMS aircraft noise study on receiver technology p 226 A92-39050****DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057****Propeller aircraft interior noise - Physical background and possible treatments p 71 A92-39082****Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089****Elasto-acoustic damped vibrations - Finite element and modal reduction methods p 218 A92-48613****[ONERA, TP NO. 1992-52] p 218 A92-48613****Progress towards quieter civil helicopters p 267 A92-52847****Silent solutions --- noise suppression for Stage 3 corporate fleets p 96 A92-53120****Experimental study of noise generation and propagation in a turbofan model p 268 A92-56169****[ONERA, TP NO. 1992-199] p 268 A92-56169****BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344****Jet noise classical theory and experiments p 268 A92-10602****Airframe noise p 268 A92-10605****Re-engining appears to offer best payback for young: Chapter 2 compliant aircraft [PNR-90848] p 98 A92-19939****The impact of aircraft noise control technology [PNR-90846] p 269 A92-20461****Jet aircraft noise at high subsonic flight Mach numbers p 270 A92-29997****[DLR-FB-91-28] p 270 A92-29997****Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 A92-32952****Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 A92-32956****Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 A92-32960****Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 A92-32961****Active vibrations and noise control for turboprop application research program activities p 271 A92-32962****Re-engining for real stage 3 compliance [PNR-90872] p 102 A92-33748****NOISE SPECTRA****Mechanical noise from large wind turbines - Experiences from Swedish prototypes p 226 A92-39046****Advanced method for single event aircraft noise analysis p 266 A92-39060****NOMENCLATURES**

- Space law and space technology - A common language p 281 A92-36695

NONDESTRUCTIVE TESTS

- Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088

State of composite material structure control in situ p 215 A92-54862**Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748****Repair procedures for advanced composites for helicopters p 4 A92-56277****Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 A92-12065****Application of eddy current techniques to graphite composite materials [ETN-92-90815] p 145 A92-21416****Training guidelines in non-destructive testing techniques [DE92-615083] p 217 A92-23258****Repair procedures for advanced composites for helicopters [MBB-UD-0606-91-PUB] p 5 A92-29874****Aging airplane repair assessment program for Airbus A300 p 57 A92-30123****Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989 [PB92-138650] p 88 A92-70591****NONEQUILIBRIUM CONDITIONS****Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 A92-15012****Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 A92-15029****Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB/FE211/S/PUB/466] p 204 A92-30674****NONEQUILIBRIUM FLOW****Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737****Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551****Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739****Entropy production in gaseous boundary layers p 183 A92-52814****Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 A92-14326****Influence of chemical modelling on hypersonic flow p 37 A92-15015****Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 A92-15029****Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296****Nonequilibrium 3D flows of air through inlets p 200 A92-27487****NONEQUILIBRIUM THERMODYNAMICS****Linear acoustics in gas mixtures with rate processes p 269 A92-15013****Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014****NONLINEAR EQUATIONS****Asymmetric oscillations in thermosolutal convection p 164 A92-19964****On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-26269****The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814****NONLINEAR EVOLUTION EQUATIONS****Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228****NONLINEAR FEEDBACK****On the nonlinear adaptive control of a flexible spacecraft p 137 A92-24499****NONLINEAR OPTICS****Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891****NONLINEAR PROGRAMMING****A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182**

- Optimal guidance anticipating missile performance
p 128 N92-27902
- NONLINEAR SYSTEMS**
Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints
p 211 A92-11815
Dynamic characterization and identification of nonlinear systems application to aeronautical structures
p 217 A92-11830
Ocean/bottom acoustic interaction with arbitrary bottom profile
[FFI-91/7009] p 242 N92-12386
- NONLINEARITY**
Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis
p 44 N92-27940
- NONUNIFORM FLOW**
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications
[ETN-92-90867] p 192 N92-19349
- NORMAL DENSITY FUNCTIONS**
Statistical methods applicable to analysis of aircraft performance data
[ESDU-91017] p 77 N92-18096
- NORMAL SHOCK WAVES**
A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55
p 14 A92-28006
- NORMALIZING (STATISTICS)**
Normalization, reliability and validation of information for spatial operations
p 157 N92-15285
- NORTH ATLANTIC TREATY ORGANIZATION (NATO)**
AGARD highlights 91/2
[ISBN-92-835-0634-0] p 286 N92-13916
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] p 91 N92-14046
Implications of interoperability and standardization for the industrial base
p 92 N92-14057
- NORTH SEA**
Investigation of convection over sea by aircraft observations
p 225 N92-26337
Cirrus clouds and condensation trail on 18 Oct. 1989 over the North Sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS
p 234 N92-26340
- NORWEGIAN SPACE PROGRAM**
The Norwegian space programme
p 121 A92-53453
Space technology and industries in Norway
[NSC-REPT(91)-8] p 153 N92-19521
The Norwegian sounding rocket and balloon programme
p 122 N92-24594
- NOSE CONES**
Computer simulation of absolute and contrast infrared signatures from missile noses
p 272 A92-29392
- NOZZLE EFFICIENCY**
Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results
[ASME PAPER 91-GT-252] p 162 A92-15657
- NOZZLE FLOW**
Impinging jets in cross-flow
p 169 A92-28942
Near-field expansion in thruster plumes
p 141 A92-52799
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] p 187 N92-14319
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] p 187 N92-14321
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
p 187 N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
p 188 N92-14326
Numerical simulations around models in hypersonic wind tunnels
p 36 N92-14998
SIMOUN and Scirocco wind tunnel nozzle viscous flow study
p 113 N92-14999
High enthalpy nozzle flows
p 36 N92-15000
Influence of chemical modelling on hypersonic flow
p 37 N92-15015
Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles
p 37 N92-15018
CFD Techniques for Propulsion Applications
[AGARD-CP-510] p 198 N92-27450
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
p 101 N92-27466
Application of finite element method to hypersonic nozzle flow computations
p 199 N92-27479

- The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle
p 200 N92-27482
- NOZZLE GEOMETRY**
A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines
[ASME PAPER 91-GT-392] p 162 A92-15722
- NUCLEAR EXPLOSION EFFECT**
Effects of ionizing and nonionizing radiation on aircraft
p 159 A92-23301
- NUCLEAR MAGNETIC RESONANCE**
Vortex nucleation in rotating superfluid He-3-B
p 271 N92-10476
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors
p 273 N92-21635
Vortex motion in rotating superfluid He-3-B
[PB92-134162] p 194 N92-21763
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
[PB92-134170] p 195 N92-22788
- NUCLEAR WARFARE**
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations
p 252 N92-19000
- NUCLEATION**
Vortex nucleation in rotating superfluid He-3-B
p 271 N92-10476
Superfluid vortex nucleation in He-3 flow
p 271 N92-10479
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
[PB92-134170] p 195 N92-22788
- NUCLIDES**
Surface activation of Concorde by Be-7
p 271 N92-23295
- NUMERICAL ANALYSIS**
Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft
p 84 N92-23951
- NUMERICAL FLOW VISUALIZATION**
Numerical flow visualization of high Reynolds number recirculated flows using an animation technique
[ONERA, TP NO. 1991-215] p 168 A92-26367
A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55
p 14 A92-28006
Mesh adaption for 2D transonic Euler flows on unstructured meshes
p 22 A92-47038
The construction, application and interpretation of three-dimensional hybrid meshes
p 263 A92-47089
Interactive visualization of CFD results ASCETE
p 190 N92-16235
Visualization of results of mathematical simulations: The contribution of MCG
p 190 N92-16236
FLOVIS (FLOW Visualizer) user manual, release 2.6, September 1990
p 190 N92-16238
Construction of a numerical optimization method for the definition of hypersupported profiles
[ONERA-RSF-43/1736-AY-146A] p 202 N92-28788
Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoil vibration
[ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-73] p 203 N92-30454
Pressure field developed by the random movement of the vortices near a wall
[ETN-92-91665] p 204 N92-32770
- NUMERICAL INTEGRATION**
Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface
p 263 A92-54574
- NUMERICAL WEATHER FORECASTING**
How accurately can we predict the errors in satellite cloud-motion winds?
p 236 A92-22607
Four-dimensional data assimilation - Comparison of variational and sequential algorithms
p 239 A92-51783
- OBJECT PROGRAMS**
IGG - An interactive 3D surface modelling and grid generation system
[AIAA PAPER 92-0073] p 256 A92-22186
- OBJECT-ORIENTED PROGRAMMING**
CFView - An advanced interactive visualization system based on object-oriented approach
[AIAA PAPER 92-0072] p 255 A92-22185

- A practical experience of Ada for developing embedded software
p 257 N92-12465
Object oriented hardware simulation of spacecraft control algorithms
p 259 N92-24487
Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs
p 136 N92-24493
- OBSERVABILITY (SYSTEMS)**
Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers
p 103 A92-29094
Design of low-sensitivity modalized observers using left eigenstructure assignment
p 104 A92-39908
- OBSERVATION**
Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday
[DLR-FB-91-30] p 233 N92-26329
Sensor fault detection on board an aircraft with observer and polynomial classifier
[DLR-FB-91-34] p 92 N92-29870
- OBSERVATION AIRCRAFT**
Aircraft observation of a small-scale solitary wave near the tropopause
p 234 N92-26336
Investigation of convection over sea by aircraft observations
p 225 N92-26337
Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements
p 240 N92-26342
- OCCUPATIONAL DISEASES**
Radiation exposure of civil air carrier crewmembers
[NLRGC/B-1-4/91] p 249 N92-33908
- OCEAN BOTTOM**
Ocean/bottom acoustic interaction with arbitrary bottom profile
[FFI-91/7009] p 242 N92-12386
- OCEAN CURRENTS**
Accurate current measurement using drogued buoys employing Decca Navigator and Argos
p 241 A92-12278
Detection of mesoscale ocean currents from Geosat altimeter data
p 242 A92-34949
Simulations of SAR imaging of ship wakes, comparing different wind growth rate models
p 242 A92-35025
An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 N92-17169
- OCEAN DATA ACQUISITIONS SYSTEMS**
Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43
[IOS-288-1991] p 243 N92-29213
- OCEAN MODELS**
A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 N92-28365
- OCEAN SURFACE**
The Hermes search and rescue operations in the open sea
[AIAA PAPER 91-4099] p 128 A92-24357
Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88
p 242 A92-34878
Measurements of ocean wave spectra with the RESSAC airborne radar
p 89 A92-35256
An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 N92-17169
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event
p 243 N92-31014
Airborne lidar and radiometric observations of PBL- and low clouds
p 240 N92-31037
- OCEANOGRAPHY**
Gravity field data products from the Aristoteles mission
p 224 N92-23925
Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43
[IOS-288-1991] p 243 N92-29213
- OCEANS**
Introduction: Ocean air observation
p 224 N92-23381
- OHMIC DISSIPATION**
Viscous and Joule heating effects on MHD free convection flow with variable plate temperature
[DE91-633612] p 273 N92-70166
- ON-LINE PROGRAMMING**
Delfi: Design, development, and applicability of expert systems shells
[ISBN-90-6275-734-0] p 259 N92-25306
- ON-LINE SYSTEMS**
Delfi: Design, development, and applicability of expert systems shells
[ISBN-90-6275-734-0] p 259 N92-25306
- ONBOARD DATA PROCESSING**
Spacecraft electromagnetic compatibility engineering
p 132 A92-33417
Implications of interoperability and standardization for the industrial base
p 92 N92-14057

Space software is first of all software p 258 N92-20590

Approach and landing assisted by onboard image processing p 64 N92-21959

Quick-look system p 224 N92-23393

ONBOARD EQUIPMENT

Some important factors in turbulence in flight measurement p 90 A92-54324

Introduction and execution of flight tests at the DLR p 85 N92-25594

Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601

On board planning of 4D-trajectories p 66 N92-27897

Potential applications of laser Doppler anemometry for in-flight measurements [NLR-TP-90163-U] p 92 N92-28654

ONE DIMENSIONAL FLOW

A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432

Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998

OPERATING SYSTEMS (COMPUTERS)

Formal specification of satellite telemetry: A practical experience p 129 N92-12456

OPERATING TEMPERATURE

High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982

Calculation of installation effects within performance computer programs p 102 N92-28465

OPERATOR PERFORMANCE

Vigilance in transport operations - Field studies in air transport and railways p 249 A92-11173

The development of a working model of flight crew underload p 249 A92-13019

OPTICAL FIBERS

Optical micromachined pressure sensor for aerospace applications p 208 A92-52370

OPTICAL FILTERS

Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393

Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108

OPTICAL HETERODYNING

Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378

OPTICAL MEASUREMENT

The role of crack growth in defect assessment [PNR-90798] p 220 N92-20909

OPTICAL MEASURING INSTRUMENTS

The use of optical sensors and signal processing gas turbine engines p 90 A92-46247

Optical micromachined pressure sensor for aerospace applications p 208 A92-52370

A new optical pressure measurement system (OPMS) p 208 A92-54303

Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304

Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

OPTICAL PROPERTIES

The near millimetre wavelength optical constants of calcium lanthanum sulphide --- for IR window applications in high-speed aircraft p 272 A92-52965

A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 N92-17434

Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 N92-34152

OPTICAL RADAR

Innovation in the laser warning sensor field p 89 A92-35742

Aircraft experiments with visible and infrared sensors p 206 A92-37159

Single alexandrite laser source for airborne DIAL system p 210 A92-51228

Seaborne lidar system p 224 N92-23389

Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378

Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347

The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304

Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306

Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326

Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014

Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037

Trial of a slant visual range measuring device p 210 N92-31043

Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059

Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106

OPTICAL SLANT RANGE

Trial of a slant visual range measuring device p 210 N92-31043

OPTICAL THICKNESS

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

OPTICAL TRACKING

Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473

Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468

OPTIMAL CONTROL

VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561

Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286

Optimal finite-thrust spacecraft trajectories [AIAA PAPER 92-4510] p 124 A92-52080

Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645

A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182

Solving the aeroassisted orbital transfer problem by using a sequential optimization approach [AIAA PAPER 92-4646] p 124 A92-55401

Sensor compatibility/optimal sensor combinations p 224 N92-23403

Trajectory optimisation and guidance strategies for reentry p 136 N92-24451

Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471

Control strategies for space systems p 137 N92-24494

Control concepts for active magnetic bearings p 214 N92-27743

OPTIMIZATION

Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299

Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations [ONERA, TP NO. 1991-187] p 10 A92-16141

Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics [ONERA, TP NO. 1992-30] p 171 A92-31488

Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691

Structural optimization at Aerospaciale Aircraft [AIAA PAPER 92-2371] p 256 A92-34542

Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908

Application of a variational method in compressible flow computations p 179 A92-47070

Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302

Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302

Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 N92-12156

Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948

Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951

Research on inverse methods and optimization in Italy p 97 N92-13956

Avionics standardization in Europe p 91 N92-14050

Aircraft tracking optimization of parameters selection p 79 N92-18585

Criticality management in space programs p 275 N92-18619

Evaluation of the COMPAS experimental system p 63 N92-19044

Robust control system design with application to high performance helicopters p 108 N92-19621

MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468

Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227

Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233

Structural optimization of aircraft practice and trends p 83 N92-23239

Control strategies for space systems p 137 N92-24494

Cluster: Fuel optimum spacecraft formation control p 122 N92-24777

Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-LS-186] p 85 N92-28469

Fundamentals of structural optimisation p 86 N92-28470

Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 N92-28471

Structural optimization of aircraft p 86 N92-28472

Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474

Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 N92-28660

Construction of a numerical optimization method for the definition of hypersupported profiles [ONERA-RS-F-43/1736-AY-146A] p 202 N92-28788

Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650

MBB-LAGRANGE: A general structural reliability and optimization structural system [MBB/FW321/S/PUB/467] p 220 N92-30423

Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424

Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675

ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515

OPTOELECTRONIC DEVICES

Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468

ORBIT CALCULATION

On the radiant determination of meteors p 283 A92-18593

Apogee manoeuvre strategies for the Inmarsat-2 spacecraft [AAS PAPER 91-364] p 123 A92-43262

Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973

ORBIT DECAY

The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967

ORBIT INSERTION

Benefits of electric propulsion for orbit injection of communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709

Apogee manoeuvre strategies for the Inmarsat-2 spacecraft [AAS PAPER 91-364] p 123 A92-43262

ORBIT PERTURBATION

Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808

Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606

Spacecraft low frequency residual acceleration [IAF PAPER 92-0970] p 133 A92-57328

Limitation of space debris in geostationary transfer orbit p 125 N92-24774

ORBIT TRANSFER VEHICLES

Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560

Solving the aeroassisted orbital transfer problem by using a sequential optimization approach [AIAA PAPER 92-4646] p 124 A92-55401

ORBITAL ELEMENTS

Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560

ORBITAL MANEUVERS

The dynamics of the Cluster spacecraft p 137 N92-24510

ORBITAL MECHANICS

Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728

ORBITAL POSITION ESTIMATION

Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755

ORBITAL RENDEZVOUS

Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 N92-24443

ORBITAL RESONANCES (CELESTIAL MECHANICS)

Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808

ORBITAL SERVICING

Problems experienced by man when constructing giant structures in space p 251 A92-40438
Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272

ORBITAL SPACE TESTS

In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410
Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133
Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774

ORBITAL VELOCITY

On the radiant determination of meteors p 283 A92-18593

ORGANISMS

A history of the scientific study of living organisms in space [IAF PAPER ST-92-0022] p 254 A92-57366

ORGANIZATIONS

Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661
Society of space studies p 283 N92-25762
Tasks of the council and general secretary of the Commission for Space Industry (Finland) p 276 N92-25785

ORGANIZING

Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957

ORTHOGONALITY

Wavelet transforms and their applications to turbulence p 177 A92-45091

ORTHOSTATIC TOLERANCE

Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547

ORTHOTROPIC PLATES

Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745

ORTHOTROPIC SHELLS

Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197

OSCILLATING FLOW

Asymmetric oscillations in thermosolutal convection p 164 A92-19964
The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758
Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347

On inertial waves in the earth's fluid core p 231 A92-37905

Influence of chemical modelling on hypersonic flow p 37 N92-15015

Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
NLR inviscid transonic unsteady loads prediction methods in aerelasticity p 45 N92-27947

OSCILLATIONS

Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234

Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235

Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795

Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 N92-20475

A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659

Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507

Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943

Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945

Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946

Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958

A review of scale effects on surfaces in unsteady motion p 46 N92-27962

Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 N92-70561

OXIDATION

Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977

OXIDATION RESISTANCE

Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 N92-12065
Large thin composite thermostructural parts p 134 N92-23821

OXYGEN ATOMS

Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

OXYGEN ISOTOPES

Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284

OXYGEN SUPPLY EQUIPMENT

Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996

OZONE

Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306

OZONE DEPLETION

Environmental impact of a future supersonic transport aircraft [ONERA, TP NO. 1991-132] p 226 A92-16108
Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193
Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645
Tracer transport in the middle atmosphere p 229 N92-26473
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306

P

PACKETS (COMMUNICATION)

Future developments in aeronautical satellite communications p 158 N92-24167

PALLADIUM ALLOYS

Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610

PANEL FLUTTER

Optimization of the flutter load by material orientation p 217 A92-15222
Linear panel flutter of an elliptic cylindrical shell p 218 A92-21216

PANEL METHOD (FLUID DYNAMICS)

Application of holomorphic vectors theory in three-dimensional potential flow problem p 165 A92-21923

Parallel algorithms for panel methods --- in fluid dynamics p 165 A92-22346

Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357

Panel method control in 3-D hyperbolic grid generation p 17 A92-39940

Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302

Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948

Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977

CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations [NLR-TR-88154-U] p 191 N92-18221

Numerical solutions for uniform flow around symmetrical bodies using panel methods [AERO-REPT-9014] p 192 N92-18320

Modernized MBB panel code: User's guide including background theory [PB92-136431] p 43 N92-22233

Panel methods for aerodynamic analysis and design p 84 N92-23955

Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods [NLR-TP-89119-U] p 47 N92-28659

Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 N92-29604

System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576

PANELS

Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310

PARABOLIC DIFFERENTIAL EQUATIONS

Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477

Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231

Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232

Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372

Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453

PARABOLIC FLIGHT

The weightless experience p 245 A92-16403
Control of blood pressure in humans under microgravity p 248 N92-23071

PARABOLIC REFLECTORS

SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065

PARACHUTE DESCENT

Balloon-borne drop capsule MIKROBA p 152 N92-24617

PARACHUTES

Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155

PARALLEL COMPUTERS

Multigrid grid generation in scalar and parallel environments p 256 A92-47084

Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125

Parallel and vector aspects of a multigrid Navier-Stokes solver [PB91-232868] p 260 N92-16645

PARALLEL PLATES

The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758

PARALLEL PROCESSING (COMPUTERS)

Parallel algorithms for panel methods --- in fluid dynamics p 165 A92-22346

Architecture and interconnects of programmable processors of radar signals p 159 A92-23042

Status and user characterization of parallel machines for digital simulation p 260 A92-23046
A fire field model implemented in a parallel computing environment p 166 A92-23252

- Parallel computing - An indispensable tool for the numerical simulation of tomorrow
[ONERA, TP NO. 1991-196] p 255 A92-26355
- Parallel processing applications for gas turbine engine control p 96 N92-11012
- A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
- Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 N92-15033
- PARALLEL PROGRAMMING**
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow
[ONERA, TP NO. 1991-196] p 255 A92-26355
- PARAMETER IDENTIFICATION**
- Model parameter identification techniques for flight flutter testing
[AERO-REPT-9105] p 107 N92-18294
- Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 N92-18790
- PARAMETERIZATION**
- Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- Investigation of convection over sea by aircraft observations p 225 N92-26337
- Fundamentals of structural optimisation p 86 N92-28470
- Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- PARTIAL DIFFERENTIAL EQUATIONS**
- The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814
- Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312
- PARTICLE ACCELERATION**
- The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft
[MPE-PREPRINT-175] p 283 N92-27049
- PARTICLE DENSITY (CONCENTRATION)**
- Low pressure impactor with electrical concentration detection p 209 N92-10534
- PARTICLE MASS**
- Low pressure impactor with electrical concentration detection p 209 N92-10534
- PARTICLE PRECIPITATION**
- Signatures of transient boundary layer processes observed with Viking p 230 A92-24532
- PARTICLE SIZE DISTRIBUTION**
- Low pressure impactor with electrical concentration detection p 209 N92-10534
- PARTICLE TRACKS**
- Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
- Visualization of instationary flows by particle traces p 189 N92-16234
- PARTICLE TRAJECTORIES**
- Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems
[PNR-90839] p 98 N92-20573
- PARTICULATE REINFORCED COMPOSITES**
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- PASSENGER AIRCRAFT**
- Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
- An aircraft manufacturer's perspective p 2 A92-33430
- Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
- Regional challenge --- flight test of Canadair Regional Jet p 74 A92-53121
- An evaluation of in-cabin safety features in passenger aircraft
[ETN-92-90656] p 55 N92-20794
- PASSIVE L-BAND RADIOMETERS**
- Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- PATENT POLICY**
- Intellectual Property Rights
[AGARD-LS-181] p 277 N92-18659
- PATENTS**
- Catalogue of ESA patents
[ESA-SP-1131-REV-1] p 287 N92-19411
- PATIENTS**
- The pilot flight surgeon bond p 250 N92-13548
- PAYLOADS**
- Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective
[MBB-UK-0143-PUB] p 216 N92-18632
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- Balloon-borne drop capsule MIKROBA p 152 N92-24617
- PENETRATION**
- Design of penetration-oriented MARV
[AIAA PAPER 92-1003] p 127 A92-33195
- PERFORMANCE PREDICTION**
- Prediction of generalized aerodynamic forces following linearized supersonic theory
[ONERA, TP NO. 1991-114] p 9 A92-16093
- Aircraft performance --- Book
[ISBN 0-521-36264-4] p 69 A92-33919
- Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system p 71 A92-35937
- Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
- Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
- A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- Influence of microvibrations on spacecraft performances p 134 N92-23825
- Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 83 N92-23950
- [AGARD-R-783] p 84 N92-23951
- Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 84 N92-23951
- Survey of experimental techniques for performance prediction p 84 N92-23954
- Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 N92-23974
- Steady and Transient Performance Prediction of Gas Turbine Engines
[AGARD-LS-183] p 101 N92-28458
- Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
- Calculation of installation effects within performance computer programs p 102 N92-28465
- PERFORMANCE TESTS**
- Mind that restyle --- failure analysis of aircraft composite structures p 53 A92-13700
- The design and testing of a radial flow turbine for aerodynamic research
[ASME PAPER 91-GT-220] p 93 A92-15636
- Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter
[FFA-TN-1991-22] p 76 N92-11993
- Heat pump systems with direct expansion ground coils
[DE92-007831] p 195 N92-23120
- Spacecraft Structures and Mechanical Testing, volume 1
[ESA-SP-321-VOL-1] p 133 N92-23780
- Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851
- A heat switch for space cryocooler applications p 160 N92-25852
- The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853
- A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881
- The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986
- Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 N92-27452
- LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration
[NLR-TP-89103-U] p 225 N92-29707
- PERIODIC VARIATIONS**
- Effect of model cooling on periodic transonic flow p 22 A92-46900
- A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements
[ETN-92-91492] p 49 N92-29889
- PERSONNEL MANAGEMENT**
- Human resource management in aviation --- Book p 250 A92-13837
- Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- PERSONNEL SELECTION**
- EEG as screening method in aeromedical selection of air crew p 246 A92-16408
- PERTURBATION**
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
- Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
- Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950
- Computation of flutter boundaries in the time and frequency domain p 46 N92-27952
- Direct coupling of fluid structure in transonic aeroelasticity p 46 N92-27954
- PERTURBATION THEORY**
- Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- Aeroacoustics in inhomogeneous flow field
[FFA-TN-1991-30] p 268 N92-12601
- Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
- PHASE TRANSFORMATIONS**
- Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications
[ETN-92-90578] p 151 N92-18479
- Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
[PB92-134170] p 195 N92-22788
- Vortex dynamics in artificially fabricated superconducting networks
[ETN-92-91296] p 160 N92-25307
- PHASE ARRAYS**
- First results from the Netherlands SAR testbed 'PHARS' --- Phased array universal SAR p 221 A92-34903
- PHONONS**
- Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146
- PHOTOELECTRON SPECTROSCOPY**
- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292
- PHOTOGRAMMETRY**
- A large format film camera for high precision object recording p 207 A92-51630
- PHOTOGRAPHIC TRACKING**
- Photographic observations of the co-located spacecraft at 19 deg West p 138 N92-24724
- PHOTOLUMINESCENCE**
- Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence
[ONERA, TP NO. 1991-94] p 206 A92-16077
- Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests
[ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
- PHOTORECONNAISSANCE**
- Testing of an experimental photographic reconnaissance system p 209 N92-25602
- PHYSICAL CHEMISTRY**
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- PHYSICAL EXERCISE**
- Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- PHYSICAL FITNESS**
- Analogy between training for dancers and problems of adjustment to microgravity - An evaluation of the subjective vertical in dancers
[IAF PAPER 90-653] p 245 A92-12125
- PHYSICAL OPTICS**
- Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
- PHYSICS**
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- PHYSIOLOGICAL EFFECTS**
- Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
- Risk to hearing from overflight noise of military aircraft
[ISVR-TR-194] p 270 N92-22241
- Study of the loss of consciousness inflight by fighter aircraft pilots
[ONERA-RTS-11/3446-EY] p 249 N92-28844
- PHYSIOLOGICAL FACTORS**
- The weightless experience p 245 A92-16403

PHYSIOLOGICAL TESTS

Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest
[IAF PAPER 91-550] p 246 A92-18547

PHYSIOLOGY

High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 A92-19000

PILOT ERROR

Stress and error in aviation --- Book p 249 A92-13015
The importance of the Type II error in aviation safety research p 250 A92-13027
How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308
Vigilance of aircrews during long-haul flights p 247 A92-45021
Human factors and simulation p 55 A92-53236

PILOT PERFORMANCE

Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
Decision support in the cockpit - Probably a good thing? p 251 A92-11135
Vigilance in transport operations - Field studies in air transport and railways p 249 A92-11173
Stress and error in aviation --- Book p 249 A92-13015
The importance of the Type II error in aviation safety research p 250 A92-13027
Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382
Heart rate variability as an index for pilot workload p 246 A92-45012
Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine p 244 A92-13547
[AGARD-AG-324]
Study of the loss of consciousness inflight by fighter aircraft pilots
[ONERA-RTS-11/3446-EY] p 249 A92-28844

PILOT SELECTION

Human resource management in aviation --- Book p 250 A92-13837
Spinal X-ray screening of high performance fighter pilots p 245 A92-15959

PILOT TRAINING

Human resource management in aviation --- Book p 250 A92-13837
JPATS escape system development p 70 A92-35434
Pragmatic simulation, basics and techniques p 251 A92-45030
Human factors and simulation p 55 A92-53236
Aviation psychology in the operational setting p 250 A92-13550
Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates
[DLR-FB-91-23] p 64 A92-20902
Opportunities for flight simulation to improve operational effectiveness p 115 A92-28523
Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315] p 118 A92-30769

PILOTS (PERSONNEL)

Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 A92-32960
Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 A92-32961

PINNING

Dynamics of vortices in high-temperature superconductors p 273 A92-10501
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 A92-21763

PIPE FLOW

Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 A92-14321
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 A92-21237
Interaction between shock wave and tubular flow p 197 A92-24392

PIPES (TUBES)

The heat pipe heat exchangers: Design, technology and applications p 154 A92-25666

PISTON ENGINES

CIS engines - The range revealed. II p 96 A92-54546

PITCH (INCLINATION)

Generalized higher harmonic control - Ten years of Aerospace experience p 104 A92-35769
An investigation into the interface between three closely spaced axisymmetric bodies at subsonic speed [CRANFIELD-AERO-9114] p 50 A92-31514

PITCHING MOMENTS

Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 A92-11967
Grid impact on 3D hypersonic flows p 39 A92-15041

Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 A92-18786
SAM/D, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 A92-70249

PLAN POSITION INDICATORS

Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291

PLANE WAVES

Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197

PLANETARY ATMOSPHERES

The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 A92-24351

PLANETARY BOUNDARY LAYER

The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345

The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
Airborne lidar and radiometric observations of PBL- and low clouds p 240 A92-31037

PLANETARY MAGNETOSPHERES

The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089

PLANETARY NEBULAE

The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171

PLANETARY WAVES

Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594

PLANNING

A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
COMPAS system concept p 63 A92-19043
Evaluation of the COMPAS operational system p 63 A92-19047
Extension of the Frankfurt COMPAS for general application p 63 A92-19048
The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 A92-19049
The role of planning systems in future air traffic management p 64 A92-19050

PLASMA DIFFUSION

Signatures of transient boundary layer processes observed with Viking p 230 A92-24532

PLASMA DRIFT

Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma [DE92-614464] p 284 A92-22653

PLASMA ENGINES

Plasma thruster development program at the IRS [IAF PAPER 92-0610] p 141 A92-57061

PLASMA GENERATORS

The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 A92-15009

PLASMA JET WIND TUNNELS

An overview of the planned aerospace test facilities at Capua, Italy [AIAA PAPER 92-3944] p 112 A92-56773
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 A92-15009

PLASMA JETS

Rotational temperature measurements in an arc jet p 177 A92-44395

Rotational temperature measurements of N2(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982
Diagnostics of thermal spraying plasma jets p 213 A92-55403

PLASMA SPRAYING

Diagnostics of thermal spraying plasma jets p 213 A92-55403
Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 A92-27422

PLASTIC AIRCRAFT STRUCTURES

The use of load enhancement factors in the certification of composite aircraft structures [NLR-TP-90068-U] p 86 A92-28649

PLATE THEORY

A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150

PLATES (STRUCTURAL MEMBERS)

Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784
Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing [CRANFIELD-AERO-9113-PT-1] p 40 A92-19679

PLUG NOZZLES

Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
Application of finite element method to hypersonic nozzle flow computations p 199 A92-27479

PLUMES

Near-field expansion in thruster plumes p 141 A92-52799
Nonparallel-flow stability of an axisymmetric buoyant plume in a following uniform stream p 183 A92-54963

A comparison of numerical predictions and experiments on under-expanded jets [AIAA PAPER 92-4027] p 141 A92-56849

POINTING CONTROL SYSTEMS

Italsat spacecraft multibeam payload antenna closed loop fine pointing system [IAF PAPER 91-509] p 129 A92-18519
Influence of microvibrations on spacecraft performances p 134 A92-23825
Design aspects of the attitude control system for the SOHO spacecraft p 135 A92-24433
SOHO: A challenge in spacecraft thermoelastic design and verification p 139 A92-25859

POLAR CAPS

Balloons for conjugate cusp studies in the 1990's p 233 A92-26315

POLAR CUSPS

The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 A92-26295
Antarctic studies of the cusp p 233 A92-26301
Requirements for coordinated Cluster and ground-based observations of the cusp p 233 A92-26318

POLAR METEOROLOGY

A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489

Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
Polar lows affecting Denmark p 237 A92-32491
Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 A92-14541
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 A92-29304
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 A92-29306

POLAR REGIONS

Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
The Venusian polar dipole p 285 A92-30456
Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645
Experiences during a 14 months overwintering with respect to potential human habitation on other planets [IAF PAPER 92-0249] p 244 A92-55688
Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 A92-20477

POLARIZATION (WAVES)

Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 A92-29877

POLARIZATION CHARACTERISTICS

Aircraft simulations of the POLDER experiment: First results p 223 A92-11471

POLICIES

The UK Parliamentary Space Committee - The emergence of a space lobby? p 281 A92-38793

- A review of UK aviation policy [TT-9107] p 5 N92-12988
- Quality assurance requirements for ESA space systems [ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- The impact of aircraft noise control technology [PNR-90846] p 269 N92-20461
- POLITICS**
- Twilight of the machine builders p 279 A92-20515
- Transfers of technology: International negotiations and work in progress p 278 N92-18665
- POLLUTION CONTROL**
- CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 N92-21740
- POLLUTION MONITORING**
- A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
- POLLUTION TRANSPORT**
- Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 N92-22406
- POLYCARBONATES**
- Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
- POLYIMIDES**
- Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
- POLYMER BLENDS**
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479
- POLYMER MATRIX COMPOSITES**
- State of composite material structure control in situ p 215 A92-54862
- POLYNOMIALS**
- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 N92-27678
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870
- POLYPHENYL ETHER**
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479
- POLYSTYRENE**
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479
- POLYTROPIC PROCESSES**
- Spherically symmetric, polytropic flow p 284 A92-20810
- PORTABLE EQUIPMENT**
- Interpretation of field measurements made with a portable albedometer p 207 A92-49773
- PORTUGAL**
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988 [AD-A246775] p 243 N92-28365
- POSITION (LOCATION)**
- Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721
- POSITION ERRORS**
- Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
- POSITION SENSING**
- Fibre optic rotary position sensors for vehicle and propulsion controls p 90 A92-46243
- POSTFLIGHT ANALYSIS**
- New results from FRECOPA analysis --- long duration exposure facility p 213 N92-27304
- POTENTIAL FLOW**
- Behavior of a suspension in the presence of a potential vortex [ONERA, TP NO. 1991-140] p 163 A92-16114
- Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
- Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
- Concerning the functional solution of transonic flows p 11 A92-21318
- Application of holomorphic vectors theory in three-dimensional potential flow problem p 165 A92-21923
- Parallel algorithms for panel methods --- in fluid dynamics p 165 A92-22346

- A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- Using Rankine vortices to model flow around a body of revolution p 169 A92-28061
- An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
- A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068
- Calculation of potential flow around airfoils using a discrete vortex method p 21 A92-45827
- A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
- A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations [NLR-TR-88154-U] p 191 N92-18221
- Inviscid drag prediction for transonic transport wings using a full-potential method [NLR-TP-89365-U] p 41 N92-20473
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- Wave drag determination in the transonic full-potential flow code MATRICES [NLR-TP-90062-U] p 47 N92-28709
- POTENTIAL THEORY**
- Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940
- POWDER METALLURGY**
- MA alloys for aerospace applications --- Mechanical Alloying p 149 A92-26128
- POWER GAIN**
- High temperature superconducting vortex flow transistor p 159 A92-38971
- POWER SPECTRA**
- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
- POWERED LIFT AIRCRAFT**
- NASA's quiet side. I p 3 A92-37875
- VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306
- Evolution of ASTOVL aircraft design p 72 A92-45311
- POWERED MODELS**
- Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel [ONERA, TP NO. 1991-219] p 111 A92-26371
- PRANDTL NUMBER**
- Coupled buoyancy and Marangoni convection in acetone Experiments and comparison with numerical simulations p 167 A92-24760
- PRECIPITATION (METEOROLOGY)**
- Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
- PRECIPITATION HARDENING**
- A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- MA alloys for aerospace applications --- Mechanical Alloying p 149 A92-26128
- Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
- PREDICTION ANALYSIS TECHNIQUES**
- How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607
- Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
- Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
- Fatigue management for the A-7P p 79 N92-18593
- Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
- A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
- Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 N92-20475
- Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 N92-20573
- A review of icing research at the Royal Aerospace Establishment p 56 N92-21689

- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction [ONERA-RS-97/5094-PY] p 269 N92-21736
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
- Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
- Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958
- Steady and Transient Performance Prediction of Gas Turbine Engines [AGARD-LS-183] p 101 N92-28458
- Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 N92-32734
- NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750
- PREDICTIONS**
- Statistical methods applicable to analysis of aircraft performance data [ESDU-91017] p 77 N92-18096
- The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967
- Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973
- Numerical prediction of boundary layers and transitional flows p 196 N92-24342
- PREDICTOR-CORRECTOR METHODS**
- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations [AIAA PAPER 92-2613] p 20 A92-45487
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 N92-14328
- Marco contract report [ETN-92-91077] p 193 N92-20232
- PREFLIGHT OPERATIONS**
- Ground operations of a HTOL airbreathing launcher [IAF PAPER 91-217] p 125 A92-14708
- PREMIXED FLAMES**
- Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
- Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573
- Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- The coherent flamelet model for propulsion applications p 147 N92-27486
- PRESSURE BREATHING**
- Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
- PRESSURE DISTRIBUTION**
- An experiment on unsteady flow over an oscillating airfoil [ASME PAPER 91-GT-181] p 8 A92-15613
- Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
- Experimental investigation of vortex dynamics on delta wings [AIAA PAPER 92-2731] p 21 A92-45565
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
- Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
- Effect of viscous damping on the response of floating bodies p 187 N92-14303
- A method of estimating a flow breakdown boundary for aeroflows and swept wings in transonic flows [ESDU-91021] p 39 N92-15970

- Excess drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution
[ESDU-91029] p 39 N92-15973
- Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate
[AERO-REPT-9008] p 40 N92-18232
- Use of CFD in the design of a modern multistage aero engine LP turbine design
[PNR-90862] p 98 N92-20179
- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
- Calculation of installation effects within performance computer programs p 102 N92-28465
- Pressure field developed by the random movement of the vortices near a wall p 204 N92-32770
- Unsteady wind tunnel tests p 109 N92-34166
- System for transonic wing design with geometric constraints based on an inverse method
[PB92-138692] p 53 N92-70576
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program
[PB92-138676] p 53 N92-70590
- PRESSURE DRAG**
A theoretical investigation of the induced drag of wing of finite aspect ratio
[CUEA/A-AERO/TR-17(1991)] p 43 N92-22193
- PRESSURE DROP**
Internal flow modelling of vortex throttles p 168 A92-27385
- PRESSURE EFFECTS**
Rotational temperature measurements of N₂(+) in an arc jet at low pressure
[AIAA PAPER 92-2967] p 273 A92-46982
- Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483
- PRESSURE GRADIENTS**
Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055
- Separation of relaminarised boundary layers
[CUEA/A-AERO/TR-16] p 195 N92-22209
- Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- PRESSURE MEASUREMENT**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet p 183 A92-52794
- A new optical pressure measurement system (OPMS)
p 208 A92-54303
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336
- Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel
[AIAA PAPER 92-4003] p 209 A92-56826
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 N92-14992
- Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow
[ONERA-NT-1991-9] p 193 N92-19932
- The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation
[PNR-90791] p 194 N92-22099
- A review of scale effects on surfaces in unsteady motion p 46 N92-27962
- Unsteady wind tunnel tests p 109 N92-34166
- PRESSURE REDUCTION**
The selective bleed variable cycle engine --- aircraft propulsion
[ASME PAPER 91-GT-388] p 93 A92-15720
- French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
- PRESSURE SENSORS**
Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method
[ONERA, TP NO. 1991-212] p 13 A92-26364
- Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
- Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302
- A new optical pressure measurement system (OPMS)
p 208 A92-54303
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation
[PNR-90791] p 194 N92-22099
- PRESSURE SUITS**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
- Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999
- PRESSURIZED CABINS**
A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
- PRIMITIVE EQUATIONS**
A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 N92-28365
- PROBABILITY DISTRIBUTION FUNCTIONS**
Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 N92-18574
- PROBABILITY THEORY**
Decision support in the cockpit - Probably a good thing? p 251 A92-11135
- Reasoning with uncertain and incomplete information in aerospace applications p 261 N92-12544
- Statistical methods applicable to analysis of aircraft performance data
[ESDU-91017] p 77 N92-18096
- Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 N92-18574
- Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDiF
[NLR-TR-88108-U] p 64 N92-19491
- PROBLEM SOLVING**
A linearised Riemann solver for Godunov-type methods
[CRANFIELD-AERO-9116] p 265 N92-19924
- Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates
[DLR-FB-91-23] p 64 N92-20902
- PROCESS CONTROL (INDUSTRY)**
Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005
- PROCUREMENT**
Procurement doubts threaten research p 275 A92-47974
- PROCUREMENT MANAGEMENT**
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] p 91 N92-14046
- PRODUCT DEVELOPMENT**
P120 programme - First results of the pre-development phase p 1 A92-14447
- Modelling of aerospace materials - Not just a pretty picture p 212 A92-33363
- The engine inside p 94 A92-36126
- German-GUS cooperation in civil aviation p 3 A92-47592
- Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- British Aerospace Hawk into the 1990s p 73 A92-50009
- 777 shaping up p 74 A92-52300
- 'A new proposal for an old problem' - The right engine for the right helicopter p 96 A92-56281
- AS 332 MKII - Development and certification p 75 A92-56343
- Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project p 209 N92-24363
- Flight simulation and digital flight controls p 115 N92-28526
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness
[AGARD-AR-315] p 118 N92-30769
- PRODUCTION ENGINEERING**
Keys to excellence in design and manufacture
[PNR-90781] p 276 N92-20927
- PRODUCTION MANAGEMENT**
The requirements and management of quality audits and reviews
[PNR-90840] p 275 N92-20458
- Keys to excellence in design and manufacture
[PNR-90781] p 276 N92-20927
- PRODUCTION PLANNING**
Concurrent engineering p 260 N92-30952
- PROGRAM VERIFICATION (COMPUTERS)**
Formal verification of a redundancy management algorithm p 257 N92-12457
- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 N92-14991
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 N92-15006
- Validation of flight critical control systems
[AGARD-AR-274] p 108 N92-20026
- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- PROGRAMMING LANGUAGES**
Test Engineering Language for Avionic Systems p 89 A92-35763
- Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 N92-14054
- PROGRESS**
Recent progress in inverse methods in France p 97 N92-13938
- PROJECT MANAGEMENT**
Organizational impediments to the reduction of costs of space programmes
[IAF PAPER 91-639] p 278 A92-20591
- Implementation of the total quality management concept within space business p 275 N92-18640
- Quality assurance requirements for ESA space systems
[ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- Simulation and control of large software projects p 258 N92-20615
- AGILE: An expert system for large space project management p 276 N92-20621
- EC funding of collaborative research projects
[PNR-90833] p 279 N92-21851
- Computational procedures for preliminary design p 84 N92-23952
- Space: Part of Europe's environment p 122 N92-70627
- PROJECT PLANNING**
Soviet space at the crossroads p 118 A92-11881
- The German Hypersonics Technology Programme - Status report 1992
[IAF PAPER 92-0867] p 127 A92-57258
- Software management strategies and practices for space systems development p 258 N92-20610
- The Norwegian sounding rocket and balloon programme p 122 N92-24594
- PROJECT SETI**
SETI in France
[IAF PAPER 92-1023] p 282 A92-57345
- PROJECTILES**
Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- PROJECTS**
Criticality management in space programs p 275 N92-18619
- PROP-FAN TECHNOLOGY**
Aerodynamic computations of high-speed transonic propellers
[ONERA, TP NO. 1991-218] p 13 A92-26370
- German-GUS cooperation in civil aviation p 3 A92-47592
- PROPELLANT COMBUSTION**
Gosling --- British Defence System rocket motor p 286 A92-30101
- PROPELLER BLADES**
Prediction of far-field harmonic noise from propellers
[ESDU-91033] p 269 N92-18074
- Selection of a laser anemometer technique for propeller tests in wind tunnels
[PB92-138510] p 118 N92-70563
- PROPELLER DRIVE**
Propeller aircraft interior noise - Physical background and possible treatments p 71 A92-39082
- PROPELLER EFFICIENCY**
Selection of a laser anemometer technique for propeller tests in wind tunnels
[PB92-138510] p 118 N92-70563
- PROPELLER NOISE**
Propeller aircraft interior noise - Physical background and possible treatments p 71 A92-39082
- A survey of active control in aircraft cabins p 72 A92-39084

- Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085
 Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087
 Prediction of far-field harmonic noise from propellers [ESDU-91033] p 269 N92-18074
 Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952

PROPELLERS

- Prediction of far-field harmonic noise from propellers [ESDU-91033] p 269 N92-18074
 Comparison of LDA and LTA applications for propeller tests in wind tunnels p 47 N92-28658
 Selection of a laser anemometer technique for propeller tests in wind tunnels [PB92-138510] p 118 N92-70563

PROPORTIONAL CONTROL

- Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
 Control concepts for active magnetic bearings p 214 N92-27743

PROPOSALS

- Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773

PROPULSION

- Nonequilibrium 3D flows of air through inlets p 200 N92-27487

PROPULSION SYSTEM CONFIGURATIONS

- STS 2000 - A reference airbreathing SSTO [AIAA PAPER 91-5013] p 126 A92-17811
 Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
 Potential hypersonic vehicles applications [AIAA PAPER 91-5086] p 1 A92-17854
 Generalities on the ramjet p 95 A92-41819
 ASTOVL engine control p 95 A92-45321
 Some implications for advanced STOVL operation from invincible class ships p 82 N92-21971
 ASTOVL propulsion systems: Configuration and concept choice [PNR-90809] p 100 N92-27041
 Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479

PROPULSION SYSTEM PERFORMANCE

- Generalities on the ramjet p 95 A92-41819
 Propulsion system performance and integration for high Mach air breathing flight p 96 A92-46429
 A research and technology program for the benefit of the Ariane family [IAF PAPER 92-0873] p 127 A92-57262
 ASTOVL propulsion systems: Configuration and concept choice [PNR-90809] p 100 N92-27041
 CFD contributions during hypersonic airplane intake design p 199 N92-27472
 The coherent flamelet model for propulsion applications p 147 N92-27486
 Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464

PROTECTION

- Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
 High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

PROTECTIVE COATINGS

- Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
 Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
 Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422

PROTOCOL (COMPUTERS)

- Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 N92-29615

PROTON BEAMS

- LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231

PSYCHOLOGICAL EFFECTS

- The long-term psychological consequences of a major aircraft accident p 249 A92-13020

PSYCHOLOGICAL FACTORS

- The weightless experience p 245 A92-16403
 The pilot flight surgeon bond p 250 N92-13548
 Domestic problems and aviator family support p 251 N92-13555
 Fear of flying p 251 N92-13556

- Multi-cultural components and keys for European worldwide space programs p 122 N92-27008

PSYCHOLOGY

- Domestic problems and aviator family support p 251 N92-13555

PUBLIC RELATIONS

- Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827

PULMONARY CIRCULATION

- Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978

PULSARS

- Neutron superfluid spin-down and magnetic field decay in pulsars p 283 A92-13865
 Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146

- Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma [DE92-614464] p 284 N92-22653

PULSE AMPLITUDE MODULATION

- Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 N92-12156

PULSE CODE MODULATION

- The basic measuring technical equipment of the DLR test aircraft p 92 N92-25592

PULSED LASERS

- A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136

PULSED RADIATION

- Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109

PUSHROOM SENSOR MODES

- Aircraft experiments with visible and infrared sensors p 206 A92-37159

PYRANOMETERS

- Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

PYROLYSIS

- Introduction of the solid fuel combustion chamber project p 142 N92-22269
 Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

Q**QUADRATIC PROGRAMMING**

- Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 N92-23238

QUALITY

- Keys to excellence in design and manufacture [PNR-90781] p 276 N92-20927

QUALITY CONTROL

- Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034
 Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548
 State of composite material structure control in situ p 215 A92-54862
 Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 N92-14042
 Constraints and difficulties in implementations of RAMS assurance programmes [MBB-UK-0141-91-PUB] p 215 N92-17544
 Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
 International collaboration in PA and safety, the Eurospace PA-Panel p 215 N92-18608
 The need for active software product assurance management for systems critical software p 257 N92-18623

- Quality assurance of safety and risk analysis p 215 N92-18629

- Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 N92-18632

- Reliability, availability, maintainability, and safety p 216 N92-18639

- A product assurance engineering concept for complex space systems p 216 N92-18645

- Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649

- Future technologies for space: New product assurance concepts p 153 N92-18650

- Collection of product assurance data and their effective utilization p 216 N92-18651

- Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005

- Quality assurance requirements for ESA space systems [ESA-PSS-01-20-ISSUE-2] p 216 N92-19108

- The requirements and management of quality audits and reviews [PNR-90840] p 275 N92-20458

- Simulation and control of large software projects p 258 N92-20615

- Training guidelines in non-destructive testing techniques [DE92-615083] p 217 N92-23258

- A manufacturer's approach to ensure long term structural integrity p 57 N92-30133

- QUARTZ CRYSTALS**
 Low pressure impactor with electrical concentration detection p 209 N92-10534

R**RADAR**

- Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668

RADAR ASTRONOMY

- Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668

RADAR CROSS SECTIONS

- Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
 Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 N92-29877

RADAR DATA

- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946

RADAR DETECTION

- Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293
 Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299
 Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
 Use of target spectrum for detection enhancement and identification p 157 N92-19155

RADAR ECHOES

- Use of target spectrum for detection enhancement and identification p 157 N92-19155

RADAR EQUIPMENT

- Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290

RADAR IMAGERY

- Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88 p 242 A92-34878
 Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943
 Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173
 Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
 Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
 SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
 Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529

RADAR MEASUREMENT

- New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
 Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
 Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173
 Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
 Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
 Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
 Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
 Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326

Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037
Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106

RADAR NAVIGATION

Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529

RADAR RANGE

Computation of aircraft geometric height under radar surveillance p 61 A92-40239

RADAR SCATTERING

Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800
Parametric cubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
Reduction of target scattering by tropospheric modification p 157 N92-19164
Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326

RADAR SIGNATURES

Use of target spectrum for detection enhancement and identification p 157 N92-19155
Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 N92-29877

RADAR TARGETS

Use of target spectrum for detection enhancement and identification p 157 N92-19155
Reduction of target scattering by tropospheric modification p 157 N92-19164

RADAR TRACKING

Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468
An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222
Reasoning with uncertain and incomplete information in aerospace applications p 261 N92-12544
The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967

RADIAL FLOW

The design and testing of a radial flow turbine for aerodynamic research [ASME PAPER 91-GT-220] p 93 A92-15636
Radial inflow turbine study [AD-A240169] p 96 N92-11015
A PC-based inverse design method for radial and mixed flow turbomachinery p 97 N92-13943
Radial inflow turbine study [AD-A252783] p 214 N92-33538

RADIANCE

Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977

RADIANT COOLING

Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392
Effect of model cooling on periodic transonic flow p 22 A92-46900
Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 N92-29713

RADIANT FLUX DENSITY

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

RADIATION ABSORPTION

Reduction of target scattering by tropospheric modification p 157 N92-19164

RADIATION DOSAGE

The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
Radiation exposure of aircrew p 246 A92-16409
Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108
Long-term exposure of bacterial spores to space p 244 N92-27126
LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231
Radiation exposure of civil air carrier crewmembers [NLRCG/B-1-4/91] p 249 N92-33908

RADIATION EFFECTS

Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301
Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings [ISBN 2-85428-288-4] p 131 A92-27130

Critical technologies: Spacecraft habitability, an update p 254 N92-27010

Long-term exposure of bacterial spores to space p 244 N92-27126

RADIATION MEASUREMENT

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771
Interpretation of field measurements made with a portable albedometer p 207 A92-49773
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
Aircraft simulations of the POLDER experiment: First results p 223 N92-11471

RADIATION PROTECTION

Radiation exposure of aircrew p 246 A92-16409

RADIATION SHIELDING

Long-term exposure of bacterial spores to space p 244 N92-27126

RADIATIVE TRANSFER

The effects of resolution on diagnostic calculations of coupling between radiation and dynamics p 238 A92-47734
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506

RADIO ASTRONOMY

SETI in France [IAF PAPER 92-1023] p 282 A92-57345
Millimeter wave technology in space p 283 N92-25782

RADIO BEACONS

Accurate current measurement using drogued buoys employing Decca Navigator and Argos p 241 A92-12278

RADIO COMMUNICATION

ARINC and commercial aircraft avionics. I p 60 A92-25655

RADIO FREQUENCY INTERFERENCE

Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721

RADIO NAVIGATION

Selected models of aircraft navigation space p 61 A92-45373
Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603

RADIO TELESCOPES

SETI in France [IAF PAPER 92-1023] p 282 A92-57345

RADIOLOGY

Spinal X-ray screening of high performance fighter pilots p 245 A92-15959

RADIOMETERS

Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

RADIOMETRIC CORRECTION

CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 N92-29707

RADIOSONDES

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

RAIL TRANSPORTATION

Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport [ETN-92-91056] p 99 N92-22406

RAMAN SPECTROSCOPY

CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376

RAMJET ENGINES

Generalities on the ramjet p 95 A92-41819
The turbo-ramjet Griffon p 286 A92-41820
The ASMP program p 3 A92-41823
Spin-offs of the solid fuel combustion chamber project p 143 N92-22275

RAMPS (STRUCTURES)

Navier-Stokes computation over a three-dimensional ramp [ONERA, TP NO. 1992-55] p 181 A92-48616
Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784

RANDOM PROCESSES

Pressure field developed by the random movement of the vortices near a wall [ETN-92-91665] p 204 N92-32770

RANDOM WALK

Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511

RANGE AND RANGE RATE TRACKING

Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 N92-14268

RANGES (FACILITIES)

Esrange: Sounding rocket and balloon facility p 126 N92-20720

RANKINE-HUGONOT RELATION

A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432

RAREFIED GAS DYNAMICS

Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients p 123 A92-15818
Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
Rarefied gas dynamics; Proceedings of the 17th International Symposium, Rheinisch-Westfälische Technische Hochschule Aachen, Germany, July 8-14, 1990 [ISBN 1-56081-122-6] p 274 A92-52701
The Harold Grad Lecture - Mathematics and the Boltzmann equation p 274 A92-52702
Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724
Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734
Fluid dynamic forces on tethered satellite systems p 124 A92-52738
Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
Force and heat transfer on a disc in rarefied flow p 25 A92-52764
Drag coefficients with applications to satellite orbits p 133 N92-11069
Transitional flows around re-entry bodies p 38 N92-15035
Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244

RAREFIED GASES

Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261
Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032

RAY TRACING

Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234
Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848

RAYLEIGH NUMBER

Asymmetric oscillations in thermosolutal convection p 164 A92-19964
Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
Convection-induced shears for general planforms p 177 A92-44352

RAYLEIGH-BENARD CONVECTION

Unsteady three-dimensional Benard convection - Light-scattering, statistics and chaos p 168 A92-27379

REACTING FLOW

Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
Model and computation of discrete jets in crossflow p 165 A92-21505
Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
Recent progress in reactive flow computations p 167 A92-26220
On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-26269
Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967

- Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573
- Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
- Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
- CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
- REACTION BONDING**
- Hot melt joints for carbon fibre reinforced composites p 213 A92-54870
- REACTION CONTROL**
- The application of high pressure ejectors to reaction control systems p 93 A92-16666
- REACTION KINETICS**
- Fast finite element solvers for reentry flows p 35 N92-14988
- Linear acoustics in gas mixtures with rate processes p 269 N92-15013
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014
- Influence of chemical modelling on hypersonic flow p 37 N92-15015
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 N92-15029
- The coherent flamelet model for propulsion applications p 147 N92-27486
- Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames [ETN-92-92103] p 205 N92-33916
- REAL GASES**
- Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030
- REAL TIME OPERATION**
- Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- Pragmatic simulation, basics and techniques p 251 A92-45030
- Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323
- A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182
- Real-time helicopter simulation using the blade element method p 264 A92-56278
- Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
- Code generation for fast DSP-based real-time control p 257 N92-12462
- Development of tactical decision aids p 90 N92-12532
- Delfi: Design, development, and applicability of expert systems shells [ISBN-90-6275-734-0] p 259 N92-25306
- Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529
- The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544
- NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 N92-29204
- REAL VARIABLES**
- Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728
- REATTACHED FLOW**
- The dynamic response of separated hypersonic flows p 38 N92-15019
- RECIPROCITY THEOREM**
- Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086
- RECIRCULATIVE FLUID FLOW**
- Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
- Numerical flow visualization of high Reynolds number recirculated flows using an animation technique [ONERA, TP NO. 1991-215] p 168 A92-26367
- Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study p 178 A92-45603
- RECOGNITION**
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870
- RECONNAISSANCE AIRCRAFT**
- Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 N92-14054
- RECOVERABLE LAUNCH VEHICLES**
- Winged launcher thermal design aspects p 127 N92-27013
- RECOVERABLE SPACECRAFT**
- On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
- RECTANGULAR WINGS**
- Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds [ESDU-91042] p 84 N92-24009
- RECYCLING**
- Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977
- REDUCED GRAVITY**
- Soviet space at the crossroads p 118 A92-11881
- Analogy between training for dancers and problems of adjustment to microgravity - An evaluation of the subjective vertical in dancers [IAF PAPER 90-653] p 245 A92-12125
- Gravitational effects on flame spreading over thin cylindrical fuel samples p 147 A92-14020
- The weightless experience p 245 A92-16403
- Columbus user support organization concept in Italy p 119 A92-32465
- USO concept in the member states - The Netherlands p 120 A92-32467
- Marangoni convection in V-shaped containers p 172 A92-37932
- Spectacular return for Columbia - Oldest Shuttle to make 13-day science mission p 128 A92-43596
- Blood lactate during leg exercise in microgravity p 247 A92-50162
- Changes observed in lymphocyte behavior during gravitational unloading p 247 A92-52395
- Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774
- The Intospace Market Development Strategy and the scenario of provided microgravity, and launch systems p 279 A92-53777
- Rib cage shape and motion in microgravity p 247 A92-56944
- CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
- Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
- Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
- Control of blood pressure in humans under microgravity p 248 N92-23071
- Balloon-borne drop capsule MIKROBA p 152 N92-24617
- Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834
- REDUNDANCY**
- Formal verification of a redundancy management algorithm p 257 N92-12457
- REENTRY**
- Large thin composite thermostructural parts p 134 N92-23821
- Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
- REENTRY EFFECTS**
- Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008
- Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
- REENTRY GUIDANCE**
- Reentry control of a low-lift maneuverable spacecraft [AIAA PAPER 92-4455] p 124 A92-55216
- GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 N92-24443
- Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- REENTRY SHIELDING**
- The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- REENTRY TRAJECTORIES**
- The Hermes search and rescue operations in the open sea [AIAA PAPER 91-4099] p 128 A92-24357
- Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
- Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
- Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- REENTRY VEHICLES**
- Potential hypersonic vehicles applications [AIAA PAPER 91-5086] p 1 A92-17854
- CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
- An aerodynamic consideration of the re-entry and aerobreaking environment of space vehicles [IAF PAPER ST-92-0017] p 27 A92-57363
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 N92-14973
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
- Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978
- Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 N92-14980
- Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
- Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 N92-14990
- Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004
- The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 N92-15025
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 N92-15029
- Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
- Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032
- Transitional flows around re-entry bodies p 38 N92-15035
- Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB/FE202/S/PUB/461] p 5 N92-30232
- LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983
- REFLECTANCE**
- Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- REFLEXES**
- Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547
- REFRACTORY MATERIALS**
- Hypersonic materials p 143 A92-18002
- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982
- REGENERATION (ENGINEERING)**
- Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892
- REGRESSION ANALYSIS**
- Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271
- REGULATIONS**
- ETOPS: A developing scene [PNR-90844] p 98 N92-20459
- The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574

- The environmental challenges for the next supersonic aircraft
[PNR-90782] p 228 N92-20928
- Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683
- Impact of regulation changes on engine design and certification
[PNR-90789] p 99 N92-22098

REGULATORS

- Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

REINFORCED PLATES

- Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- Optimization of the flutter load by material orientation p 217 A92-15222

REINFORCED SHELLS

- A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866

RELATIVISTIC ELECTRON BEAMS

- Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523

RELAXATION METHOD (MATHEMATICS)

- Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897

RELIABILITY

- Lite-Sat's for specific communication tasks p 156 N92-15232
- Constraints and difficulties in implementations of RAMS assurance programmes
[MBB-UK-0141-91-PUB] p 215 N92-17544
- Fatigue safety factor: Assessment of associated safety level p 220 N92-18573
- Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472] p 87 N92-29650
- A manufacturer's approach to ensure long term structural integrity p 57 N92-30133

RELIABILITY ANALYSIS

- Normalization, reliability and validation of information for spatial operations p 157 N92-15285
- Fatigue safety factor: Assessment of associated safety level p 220 N92-18573
- Tornado structural fatigue life assessment of the German Air Force p 79 N92-18592
- Fatigue management for the A-7P p 79 N92-18593
- Reliability modeling for non-electronic systems p 216 N92-18633
- A managerial approach for reliability verification of mechanical equipment
[MBB-UK-0140-PUB] p 275 N92-18634
- Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber)
[MBB-UK-0144-PUB] p 142 N92-18636
- Reliability, availability, maintainability, and safety p 216 N92-18639
- A product assurance engineering concept for complex space systems p 216 N92-18645
- RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 N92-18647
- Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649
- Future technologies for space: New product assurance concepts p 153 N92-18650

RELIABILITY ENGINEERING

- Space Product Assurance for Europe in the 1990s: An ESA Symposium
[ESA-SP-316] p 152 N92-18607
- The need for active software product assurance management for systems critical software p 257 N92-18623
- System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624
- Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective
[MBB-UK-0143-PUB] p 216 N92-18632
- Reliability modeling for non-electronic systems p 216 N92-18633
- Safety risk management for ESA space systems p 153 N92-18635
- Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- Future technologies for space: New product assurance concepts p 153 N92-18650

- Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005

- MBB-LAGRANGE: A general structural reliability and optimization structural system
[MBB/FW321/S/PUB/467] p 220 N92-30423

REMOTE CONTROL

- The USOCs, the resources management, and their links with telepresence p 276 N92-33466

REMOTE SENSING

- Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
- Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104
- Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
- Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943
- Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949
- Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- Simulations of SAR imaging of ship wakes, comparing different wind growth rate models p 242 A92-35025
- Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- The French space program for earth observation p 222 A92-37154
- Aircraft experiments with visible and infrared sensors p 206 A92-37159
- The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing p 223 A92-44167
- Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
- The Swedish space program p 121 A92-53452
- Main activities conducted under the International Space Year Panel of Experts on Education and Applications
[IAF PAPER 92-0466] p 274 A92-55806
- Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
- Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- CO2 laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535
- Recommended system concept p 224 N92-23383
- National user interfaces p 224 N92-23407
- Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- The main lines of the research programs remote sensing: Climate and environment
[BCRS-91-25] p 230 N92-29499
- Activities report of the Netherlands Remote Sensing Board (with abridged version)
[ETN-92-91352] p 225 N92-29688
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration
[NLR-TP-89103-U] p 225 N92-29707
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4)
[ESA-SP-1141] p 122 N92-29879
- Examination and mapping of forest damage using remote sensing methods p 225 N92-33691
- [ETN-92-91913] p 225 N92-33691
- Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

- REMOTE SENSORS**
- Introduction: Ocean air observation p 224 N92-23381
- Preconsiderations on aircraft integration p 224 N92-23402
- Sensor compatibility/optimal sensor combinations p 224 N92-23403
- Activities report of the Netherlands Remote Sensing Board (with abridged version)
[ETN-92-91352] p 225 N92-29688

- RENDEZVOUS GUIDANCE**
- Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- RENDEZVOUS TRAJECTORIES**
- Time-to-go estimation from infrared images p 61 A92-48308

- REPORTS**
- DLR research reports and communications
[ETN-92-91391] p 287 N92-29218

- Activities report of the Netherlands Remote Sensing Board (with abridged version)
[ETN-92-91352] p 225 N92-29688
- Astronautics 1977-1990
[AERONOMICA-ACTA-F-42-1991] p 287 N92-30996

REQUIREMENTS

- Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
- Software product assurance requirements for ESA space systems
[ESA-PSS-01-21-ISSUE-2] p 257 N92-14631
- Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- Quality assurance requirements for ESA space systems
[ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- High energy propulsion units for the year 2000
[ETN-92-90989] p 129 N92-20249
- Saenger: The reference concept and its technological requirements - aerothermodynamics
[MBB-FE-202-S-PUB-0463-A] p 128 N92-29629
- Aerothermodynamic challenges of the Saenger space-transportation system
[MBB-FE-202-S-PUB-0462-A] p 129 N92-29680
- Maintainability requirements for ESA space systems
[ESA-PSS-01-50-ISSUE-1] p 217 N92-29878

RESCUE OPERATIONS

- The Hermes search and rescue operations in the open sea
[AIAA PAPER 91-4099] p 128 A92-24357
- Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774

RESEARCH

- Aeronautical Engineering Group publications, 1950 - present
[AERO-REPT-8907] p 202 N92-29683

RESEARCH AIRCRAFT

- Air transport research in Germany p 1 A92-17095
- Aerodynamic development of the X-31 aircraft for the high angle of attack region
[MBB-FE211-S-PUB-452] p 77 N92-17313
- X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
- The DLR meteorological research aircraft Falcon p 240 N92-26348
- The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349

RESEARCH AND DEVELOPMENT

- The design and testing of a radial flow turbine for aerodynamic research
[ASME PAPER 91-GT-220] p 93 A92-15636
- Air transport research in Germany p 1 A92-21014
- Procurement doubts threaten research p 275 A92-47974
- Organization and technical status of the NH90 European helicopter programme p 4 A92-56306
- The SR3 low density wind tunnel - Facility capabilities and research development
[AIAA PAPER 92-3972] p 112 A92-56798
- Plasma thruster development program at the IRS
[IAF PAPER 92-0610] p 141 A92-57061
- A research and technology program for the benefit of the Ariane family
[IAF PAPER 92-0873] p 127 A92-57262
- Eighty years of aerospace technique through ATMA bulletins
[ETN-91-90097] p 286 N92-11963
- The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] p 91 N92-14046
- Why is space software special? p 258 N92-20626
- Second Meeting of Finnish Space Researchers
[REPT-117(1990)] p 282 N92-25758
- MBB Deutsche Aerospace financial year
[ETN-92-91908] p 276 N92-33686

RESEARCH FACILITIES

- Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme p 70 A92-35767
- Aerospace technology: Technical data and information on foreign test facilities
[GAC/NSIAD-90-71FS] p 113 N92-13076
- Aerothermodynamic challenges for ESA programmes p 34 N92-14974
- The Goldstein Engineering Research Laboratory
[AERO-REPT-8906] p 5 N92-18322
- DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
- Use of a research simulator for the development of new concepts of flight control p 116 N92-28543

The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 N92-28579

RESEARCH MANAGEMENT
Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120
The main lines of the research programs remote sensing: Climate and environment [BCRS-91-25] p 230 N92-29499
Activities report of the Netherlands Remote Sensing Board (with abridged version) [ETN-92-91352] p 225 N92-29688

RESEARCH PROJECTS
Review of aerodynamic design in the Netherlands p 76 N92-13929
DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
DLR research reports and communications [ETN-92-91391] p 287 N92-29218
Activities report of the DLR [ETN-92-91392] p 287 N92-29219

RESIDENTIAL AREAS
Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120

RESIDUAL STRENGTH
Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045

RESILIENCE
Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 N92-14042

RESIN MATRIX COMPOSITES
Hot melt joints for carbon fibre reinforced composites p 213 N92-54870

RESONANT FREQUENCIES
Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547
Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 N92-23844

RESONANT VIBRATION
Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045

RESOURCES MANAGEMENT
The USOCs, the resources management, and their links with telescience p 276 N92-33466

RESPIRATORS
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

RESPIRATORY SYSTEM
Rib cage shape and motion in microgravity p 247 A92-56944

RETIREMENT FOR CAUSE
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950

REYNOLDS EQUATION
The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471

REYNOLDS NUMBER
Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
A review of scale effects in unsteady aerodynamics p 24 A92-50121
Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168
A review of scale effects on surfaces in unsteady motion p 46 N92-27962

REYNOLDS STRESS
Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803
Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
Three-dimensional separated flows p 173 A92-40088
Convection-induced shears for general planforms p 177 A92-44352
Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 N92-32725

RIBLETS
Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918

RIEMANN MANIFOLD
Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038

RIGID STRUCTURES
Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
On the analysis of liquid filled free-free tanks p 196 N92-23843

RING STRUCTURES
The stability of graphite brushes at high velocity [ETN-91-90176] p 160 N92-12184

RISK
Reducing risks p 278 A92-22725
Insurers lose from high-risk deals p 279 A92-35474
Quality assurance of safety and risk analysis p 215 N92-18629
Why quantify risk? p 153 N92-18637

RIVETED JOINTS
Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP p 219 N92-14420

ROBOT ARMS
Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313
Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073

ROBOT CONTROL
Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313

ROBOT DYNAMICS
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 N92-24351

ROBOTICS
In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators [NLR-TP-90028-U] p 261 N92-28648

ROBUSTNESS (MATHEMATICS)
An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
Robust control system design with application to high performance helicopters p 108 N92-19621
Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471

ROCKET ENGINE DESIGN
Gosling --- British Defence System rocket motor p 286 A92-30101
Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber) [MBB-UK-0144-PUB] p 142 N92-18636

ROCKET EXHAUST
A comparison of numerical predictions and experiments on under-expanded jets [AIAA PAPER 92-4027] p 141 A92-56849

ROCKET LAUNCHING
Esrang: Sounding rocket and balloon facility p 126 N92-20720
Dynamic load cases on Ariane 5 p 127 N92-23797

ROCKET NOZZLES
Gosling --- British Defence System rocket motor p 286 A92-30101

ROLL
An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 N92-13015
A background to the handling qualities of aircraft [ESDU-92006] p 109 N92-32780

ROLLING MOMENTS
Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds [ESDU-92002-SUPPL] p 51 N92-32782

ROTARY WING AIRCRAFT
An experimental investigation of the oblique blade-vortex interaction p 19 A92-43447

Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332
Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340

Rotorcraft system identification [AGARD-AR-280] p 75 N92-11001

ROTARY WINGS
Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139
Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors [ONERA, TP NO. 1991-178] p 10 A92-16140
Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations [ONERA, TP NO. 1991-187] p 10 A92-16141
Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
Generalized higher harmonic control - Ten years of Aerospace experience p 104 A92-35769
LAH main rotor model test at the DNW p 70 A92-35771
Design and manufacturing of torsional flexible blade models p 71 A92-35780
Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics [ONERA, TP NO. 1992-27] p 73 A92-48589
Influence of geometrical parameters on helicopter rotor high speed impulsive noise [ONERA, TP NO. 1992-40] p 267 A92-48601
The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849
Simulation of helicopter see-saw rotor motion p 74 A92-56287
Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
Measurements of the dynamic stall vortex convection speed p 27 A92-56351
A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741

ROTATING BODIES
Rotational temperature measurements in an arc jet p 177 A92-44395
The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449

ROTATING DISKS
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950

ROTATING FLUIDS
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
Vortices on accretion disks p 284 A92-27396
Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172
The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 N92-21763

- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3
[PB92-134147] p 269 N92-21773
- Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256] p 265 N92-23665
- ROTATING PLASMAS**
Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma
[DE92-614464] p 284 N92-22653
- ROTATING SHAFTS**
Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow
[ETN-92-91489] p 202 N92-29926
- ROTATION**
Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 N92-12203
Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
- ROTATIONAL SPECTRA**
Rotational temperature measurements of N₂(+) in an arc jet at low pressure
[AIAA PAPER 92-2967] p 273 A92-46982
- ROTOR AERODYNAMICS**
An Axial Turbopropeller
[ASME PAPER 91-GT-1] p 211 A92-15501
Quasi-three-dimensional characteristics method for a supersonic compressor rotor
[ASME PAPER 91-GT-81] p 7 A92-15549
Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements
[ONERA, TP NO. 1991-157] p 9 A92-16125
Supersonic stator-rotor interaction in a turbine stage
[ONERA, TP NO. 1991-166] p 10 A92-16133
Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations
[ONERA, TP NO. 1991-187] p 10 A92-16141
Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme
p 70 A92-35767
General model of isolated helicopter blade for stability investigation p 71 A92-35774
Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
Experimental and computational studies of hovering rotor flows p 22 A92-46954
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics
[ONERA, TP NO. 1992-27] p 73 A92-48589
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
The computation and validation of hovering rotor performance p 74 A92-56285
Blade instability of horizontally stoppable rotors p 106 A92-56308
Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
Measurements of the dynamic stall vortex convection speed p 27 A92-56351
Radial inflow turbine study
[AD-A240169] p 96 N92-11015
LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
Radial inflow turbine study
[AD-A252783] p 214 N92-33538
- ROTOR BLADES**
Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel
[ONERA, TP NO. 1991-124] p 9 A92-16102
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
General model of isolated helicopter blade for stability investigation p 71 A92-35774
The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849
The interaction between a high-frequency gust and a blade row p 267 A92-54484

- Blade instability of horizontally stoppable rotors p 106 A92-56308
- Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332
- A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
- Numerical simulation of unsteady rotor wakes p 27 A92-56352
- LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
- ROTOR BLADES (TURBOMACHINERY)**
Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548
Real-time helicopter simulation using the blade element method p 264 A92-56278
Trimming rotor blades with periodically deflecting trailing edge flaps p 106 A92-56283
Recent progress in inverse methods in France p 97 N92-13938
- ROTOR BODY INTERACTIONS**
Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements
[ONERA, TP NO. 1991-157] p 9 A92-16125
Supersonic stator-rotor interaction in a turbine stage
[ONERA, TP NO. 1991-166] p 10 A92-16133
Experimental and theoretical studies on helicopter rotor fuselage interaction
[ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction
[ONERA, TP NO. 1991-198] p 13 A92-26357
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
- ROTOR DYNAMICS**
Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 N92-14360
- ROTOR SPEED**
An aerodynamic analysis of 'seesaw' type rotor for autogyro p 24 A92-52034
- ROTORCRAFT AIRCRAFT**
Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
Technology exploitation for in-service support of future rotorcraft p 4 A92-56327
- ROTORS**
On the limitations of Froude's actuator disc concept
[ETN-91-90136] p 29 N92-11973
- ROUTES**
A constraint satisfaction approach to operative management of aircraft routing p 54 A92-25181
Air Vehicle Mission Control and Management
[AGARD-CP-504] p 5 N92-27887
On board planning of 4D-trajectories p 66 N92-27897
- RUDDERS**
Mind that restyle --- failure analysis of aircraft composite structures p 53 A92-13700
- RUNGE-KUTTA METHOD**
Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157
Improved shock-capturing of Jameson's scheme for the Euler equations
[PB92-148758] p 196 N92-23251
Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
- RUNWAY CONDITIONS**
Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323
- RUNWAYS**
DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
Computation of aircraft noise exposure using digitized topography data p 227 A92-39058

SAAB AIRCRAFT

- A manufacturer's approach to ensure long term structural integrity p 57 N92-30133
Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952

SAFETY

- Software methodologies for safety critical systems p 257 N92-12467
Launch Bases and Control Infrastructures for Spacecraft
[ESA-SP-342] p 125 N92-20715

SAFETY DEVICES

- An evaluation of in-cabin safety features in passenger aircraft
[ETN-92-90656] p 55 N92-20794

SAFETY FACTORS

- Security rights in aircraft under Belgian law p 280 A92-35589
Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
Dutch security rights in aircraft and engines p 280 A92-35594
Fatigue safety factor: Assessment of associated safety level p 220 N92-18573

SAFETY MANAGEMENT

- Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990
[ISBN 0-903409-78-X] p 54 A92-39301
How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308
Constraints and difficulties in implementations of RAMS assurance programmes
[MBB-UK-0141-91-PUB] p 215 N92-17544
Space Product Assurance for Europe in the 1990s: An ESA Symposium
[ESA-SP-316] p 152 N92-18607
International collaboration in PA and safety, the Eurospace PA-Panel p 215 N92-18608
Organisational robustness for manned space flight p 152 N92-18618
The need for active software product assurance management for systems critical software p 257 N92-18623
System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624
Quality assurance of safety and risk analysis p 215 N92-18629
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630
Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective
[MBB-UK-0143-PUB] p 216 N92-18632
Reliability modeling for non-electronic systems p 216 N92-18633
A managerial approach for reliability verification of mechanical equipment
[MBB-UK-0140-PUB] p 275 N92-18634
Safety risk management for ESA space systems p 153 N92-18635
Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber)
[MBB-UK-0144-PUB] p 142 N92-18636
Why quantify risk? p 153 N92-18637
Reliability, availability, maintainability, and safety p 216 N92-18639
Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649
Collection of product assurance data and their effective utilization p 216 N92-18651
An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786

SAILS

- Yacht sail aerodynamics. Part 1: Optimising overall performance
[TT-8903-PT-1] p 52 N92-70499

- Yacht sail aerodynamics. Part 3: Achievable jibsail specification
[ISBN-0-904947-17-3] p 52 N92-70513

- Yacht sail aerodynamics. Part 2: Achievable mainsail specification
[ISBN-0-904947-16-5] p 52 N92-70514

SALYUT SPACE STATION

- The Reentry of Salyut-7/Kosmos-1686
[ESA-SP-345] p 134 N92-23967
Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973

SARSAT

- Error analysis of the COSPAS SARSAT system
p 129 A92-21288

SATELLITE ALTIMETRY

- Detection of mesoscale ocean currents from Geosat altimeter data
p 242 A92-34949

SATELLITE ATMOSPHERES

- Titan's atmosphere structure from Huygen's-ASI measurements
p 285 A92-32398

SATELLITE ATTITUDE CONTROL

- Dynamics of spacecraft
p 123 A92-33404
Atmospheric re-entry
p 123 A92-33409
Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCS
p 136 A92-24493
Spacecraft attitude control using magnetic torquers and gas jets
p 137 A92-24496
Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft
p 137 A92-24504
Approach to the evaluation of interferences between co-located geostationary spacecraft
p 137 A92-24721
Relegation of the proper rotation in attitude dynamics of a spacecraft
p 138 A92-24728
Estimation of attitude thruster activity of spacecraft on Sun acquisition mode
p 138 A92-24755

SATELLITE COMMUNICATION

- The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service
p 59 A92-13852
Spacecraft systems engineering --- Book
[ISBN 0-471-92794-5]
p 120 A92-33401
Convergence of telecommunication technologies - Some legal aspects
p 281 A92-36682
The Norwegian space programme
p 121 A92-53453
Normalization, reliability and validation of information for spatial operations
p 157 A92-15285
Inmarsat aeronautical mobile satellite system: Internetworking issues
p 158 A92-24098
Future developments in aeronautical satellite communications
p 158 A92-24167

SATELLITE CONFIGURATIONS

- The enhancement of the Italsat spacecraft - A step forward the communication satellites
[IAF PAPER 91-473]
p 131 A92-18494
LEOSTAR - A small spacecraft for LEO communications missions
p 120 A92-46468
Cluster: Fuel optimum spacecraft formation control
p 122 A92-24777

SATELLITE CONTROL

- Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs
p 64 A92-20611

SATELLITE DOPPLER POSITIONING

- Error analysis of the COSPAS SARSAT system
p 129 A92-21288

SATELLITE DRAG

- Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients
p 123 A92-15818

SATELLITE GROUND SUPPORT

- Columbus user support organization concept in Italy
p 119 A92-32465
USO concept in the member states - Belgium
p 119 A92-32466
Swedish user support for Columbus
p 120 A92-32469

SATELLITE IMAGERY

- How accurately can we predict the errors in satellite cloud-motion winds?
p 236 A92-22607
A most beautiful polar low - A case study of a polar low development in the Bear Island region
p 237 A92-32487
The French space program for earth observation
p 222 A92-37154
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper
p 222 A92-37633
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment
[BCRS-91-28]
p 225 A92-30230

SATELLITE INSTRUMENTS

- The effects of resolution on diagnostic calculations of coupling between radiation and dynamics
p 238 A92-47734
Aeronautical satellite system test and implementation
p 158 A92-24095

SATELLITE LIFETIME

- The Reentry of Salyut-7/Kosmos-1686
[ESA-SP-345]
p 134 A92-23967
Debris reentry prediction: Salyut-7/Kosmos-1686
p 125 A92-23973
Limitation of space debris in geostationary transfer orbit
p 125 A92-24774

SATELLITE NAVIGATION SYSTEMS

- The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system
p 58 A92-13851
The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service
p 59 A92-13852
GPS/GLONASS user systems in Sweden
p 61 A92-38384

SATELLITE NETWORKS

- Communication satellite system beyond the year 2000
[IAF PAPER 91-495]
p 155 A92-18509
LEOSTAR - A small spacecraft for LEO communications missions
p 120 A92-46468
Aeronautical satellite system test and implementation
p 158 A92-24095
Inmarsat aeronautical mobile satellite system: Internetworking issues
p 158 A92-24098
Issues for the integration of satellite and terrestrial cellular networks for mobile communications
p 159 A92-30941

SATELLITE OBSERVATION

- Signatures of transient boundary layer processes observed with Viking
p 230 A92-24532
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models
[FFI-91/7007-VOL-3]
p 156 A92-12157
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990
[ETN-92-91068]
p 287 A92-24351
Photographic observations of the co-located spacecraft at 19 deg West
p 138 A92-24724
The need of coordinated observations in space and from ground
p 233 A92-26310
Requirements for coordinated Cluster and ground-based observations of the cusp
p 233 A92-26318
Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS
p 234 A92-26340
Tracer transport in the middle atmosphere
p 229 A92-26473

SATELLITE ORBITS

- Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients
p 123 A92-15818
The upper atmosphere as sensed by satellite orbits
p 230 A92-30638
Drag coefficients with applications to satellite orbits
p 133 A92-11069

SATELLITE ROTATION

- Relegation of the proper rotation in attitude dynamics of a spacecraft
p 138 A92-24728

SATELLITE SOLAR ENERGY CONVERSION

- SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Ecole Supérieure d'Electricité, Gif-sur-Yvette, France, Aug. 27-30, 1991
p 226 A92-40401

SATELLITE SOUNDING

- A comparison of satellite sounding data and aircraft measurements within a mature polar low
p 237 A92-32489

SATELLITE TEMPERATURE

- Spacecraft thermal control coatings
p 151 A92-24829

SATELLITE TRACKING

- Photographic observations of the co-located spacecraft at 19 deg West
p 138 A92-24724

SATELLITE-BORNE INSTRUMENTS

- Dual technique magnetometer experiment for the Cassini Orbiter spacecraft
p 139 A92-53412
The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415
Investigations preparatory to the Wet Satellite Model Experiment
[NLR-TP-91219-U]
p 139 A92-32834
Dual technique magnetometer experiment for the Cassini Orbiter spacecraft
p 139 A92-53412
The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415

SCALARS

- Multigrid grid generation in scalar and parallel environments
p 256 A92-47084

SCALE EFFECT

- The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum
p 15 A92-32323
A review of scale effects in unsteady aerodynamics
p 24 A92-50121
A review of scale effects on surfaces in unsteady motion
p 46 A92-27962

SCALE MODELS

- LAH main rotor model test at the DNW
p 70 A92-35771
Experimental study of noise generation and propagation in a turbofan model
[ONERA, TP NO. 1992-199]
p 268 A92-56169

- BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW
p 268 A92-56344
Control aspects of the transition from transversal to transonic flow, step effects
[ETN-91-90106]
p 29 A92-11981
Survey of experimental techniques for performance prediction
p 84 A92-23954

SCATTEROMETERS

- Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields
p 222 A92-35302

SCENE ANALYSIS

- Time-to-go estimation from infrared images
p 61 A92-48308

SCHEDULES

- French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes
p 252 A92-18994

SCHEDULING

- Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers
p 103 A92-29094
Process/object-oriented Ada software design for an experimental helicopter
p 257 A92-12461
Delfi: Design, development, and applicability of expert systems shells
[ISBN-90-6275-734-0]
p 259 A92-25306

SCHLIEREN PHOTOGRAPHY

- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
[NLR-TP-91117-U]
p 51 A92-32732

SCIENTIFIC SATELLITES

- Gravity field data products from the Aristoteles mission
p 224 A92-23925
Astronautics 1977-1990
[AERONOMICA-ACTA-F-42-1991]
p 287 A92-30996

SEA LAUNCHING

- United Kingdom approach to deriving military ship helicopter operating limits
p 82 A92-21966

SEA WATER

- An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084]
p 242 A92-17169

SEARCH RADAR

- An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role
[ETN-91-99987]
p 156 A92-11222

SEASAT SATELLITES

- The design of spaceborne synthetic aperture radar
[ETN-91-99986]
p 156 A92-10114

SECONDARY FLOW

- Turbulence modelling for secondary flow prediction in a turbine cascade
[ASME PAPER 91-GT-57]
p 7 A92-15535
3-D loss prediction based on secondary flow and blade shear layer interaction
[ASME PAPER 91-GT-59]
p 7 A92-15536
Secondary flow investigation inside the passage of a compressor cascade
p 19 A92-42124
Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code
[CERT-RT-63/5618-54]
p 185 A92-11306
An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
p 31 A92-13011
Time-marching methods for secondary flow analysis in curved ducts
p 198 A92-27454
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade
p 198 A92-27457

SECONDARY RADAR

- The European ATC challenge
p 58 A92-11877
Analysis and design optimization of monopulse receivers for secondary surveillance radar
p 155 A92-12299
Quantitative estimation of secondary surveillance radar information
p 59 A92-24943
Monopulse secondary surveillance radar and the mode-S surveillance system
p 62 A92-53239

SEDATIVES

- Extended Ly Alpha emission around quasars at z of more than 3.6
p 247 A92-56703

SELF TESTS

- Full MACS controller-based self test module for spacecraft units and related testing facilities
p 136 A92-24474

SEMIEMPIRICAL EQUATIONS

- A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics
[ETN-92-91491]
p 49 A92-29741

SENSITIVITY

- Integrated Design Analysis and Optimisation of Aircraft Structures
[AGARD-R-784]
p 83 A92-23227

SENSORY FEEDBACK

Domestic problems and aviator family support
p 251 N92-13555

SEPARATED FLOW

Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
Secondary separation from a slender wing p 6 A92-13448

A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345
Using Rankine vortices to model flow around a body of revolution p 169 A92-28061
Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme p 70 A92-35767

Three-dimensional separated flows

p 173 A92-40088
Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method [ONERA, TP NO. 1992-1] p 23 A92-48577

A review of scale effects in unsteady aerodynamics p 24 A92-50121

A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028
Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique p 26 A92-54308

Vortex Flow Aerodynamics [AGARD-CP-494] p 30 N92-12996
Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997

On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
Review of aircraft dynamic loads due to flow separation p 31 N92-13008

The dynamic response of separated hypersonic flows p 38 N92-15019

Mean wind speeds over hills and other topography [ESDU-91043] p 240 N92-17853

Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784

Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168

A review of scale effects on surfaces in unsteady motion p 46 N92-27962
Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464

Vortex flow aerodynamics [AGARD-AR-299] p 50 N92-30947

Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765

SEQUENCING

A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178

SERVICE LIFE

Ageing airliner census - Still flying safely p 54 A92-38374

Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 N92-15065
The G-222 aircraft individual tracking programme p 78 N92-18582

A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795

SHAPES

A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741

Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742

SHARP LEADING EDGES

Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477

Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 N92-12998

Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000

Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001

Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657

An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 N92-32732

Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 N92-32776

SHEAR FLOW

Turbulent energy budgets in impinging zones p 17 A92-40081

Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093
Convection-induced shears for general planforms p 177 A92-44352

Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604

Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
Physical and computational modelling of stratified shear flows [AERO-REPT-8909] p 190 N92-17974

The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933

The 8th Symposium on Turbulent Shear Flows. Volume 2: 19-31, poster sessions. [AD-A243810] p 192 N92-18934

SHEAR LAYERS

High resolution schemes for steady flow computation p 161 A92-10036

3-D loss prediction based on secondary flow and blade shear layer interaction [ASME PAPER 91-GT-59] p 7 A92-15536

Final equilibrium state of a two-dimensional shear layer p 164 A92-19967

Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221

Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161

The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487

The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933

SHEAR STRESS

On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319

SHELL THEORY

A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150

SHIPS

Simulations of SAR imaging of ship wakes, comparing different wind growth rate models p 242 A92-35025

Safety at sea and in the air - Taking stock together: Proceedings of the Conference, London, England, Nov. 13-15, 1990 [ISBN 0-903409-78-X] p 54 A92-39301

How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308

SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157

Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951

United Kingdom approach to deriving military ship helicopter operating limits p 82 N92-21966

Limitations on helicopter operations in the aeronaval environment p 82 N92-21973

Seaborne lidar system p 224 N92-23389

Yacht sail aerodynamics. Part 1: Optimising overall performance [TT-8903-PT-1] p 52 N92-70499

SHOCK DISCONTINUITY

Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997

SHOCK LAYERS

Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008

Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014

Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 N92-17311

SHOCK TESTS

Examination of aircraft warning and caution lights after shock testing [NLR-TP-89284-U] p 58 N92-30474

SHOCK TUBES

A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300

SHOCK TUNNELS

Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076

SHOCK WAVE INTERACTION

A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55 p 14 A92-28006

Cylinder-induced shock-wave boundary-layer interaction p 15 A92-31188

Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver p 23 A92-48207

Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477

Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755

Interaction between shock wave and tubular flow p 197 N92-24392

SHOCK WAVE PROPAGATION

Spherically symmetric, polytropic flow p 284 A92-20810

Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724

Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785

SHOCK WAVES

A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432

Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 N92-14991

Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994

Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023

Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317

Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 N92-19916

Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 N92-19932

Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703

Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 N92-23251

SHORT CRACKS

Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767

Short cracks and durability analysis of the Fokker 100 wing/fuselage structure [NLR-TP-90336-U] p 220 N92-29603

SHORT HAUL AIRCRAFT

NASA's quiet side. I p 3 A92-37875

SHORT TAKEOFF AIRCRAFT

RAE Bedford VAAC research project --- VSTOL aircraft advanced flight control p 104 A92-40039

Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302

ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515

SIDESLIP

Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack [ESDU-91031] p 39 N92-15971

SIGNAL ANALYSIS

Spectral analysis with a LDA in high speed flow p 209 A92-54339

Quick-look system p 224 N92-23393

SIGNAL ANALYZERS

Code generation for fast DSP-based real-time control p 257 N92-12462

SIGNAL PROCESSING

Transmission fidelity monitoring - A single board computer architecture p 89 A92-35765

The use of optical sensors and signal processing gas turbine engines p 90 A92-46247

Code generation for fast DSP-based real-time control p 257 N92-12462

SILENCE

Inter-noise 90: Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vols. 1 & 2 [ISBN 91-7848-224-0] p 266 A92-39042

SILICON

Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379

SILICON CARBIDES

The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083

SIMULATION

- The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology [ASME PAPER 91-GT-124] p 8 A92-15569
- Aircraft simulations of the POLDER experiment: First results p 223 A92-11471
- The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 A92-18934
- Optimal guidance anticipating missile performance p 128 A92-27902

SIMULATORS

- Conception of a UHB engine simulator for the essential characteristics of a true-scale engine --- ultrahigh bypass p 112 A92-54322
- Development environment for digital manipulator simulators [PB91-222190] p 213 A92-16313
- Use of a virtual cockpit for the development of a future transport aircraft p 117 A92-28547
- The role of systems simulation for the development and qualification of ATTAS p 117 A92-28548
- The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 A92-28579
- NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 A92-29204

SINGLE CRYSTALS

- High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578

SINGLE ENGINE AIRCRAFT

- The development of a new light, single engine helicopter family p 70 A92-35734

SINGLE STAGE ROCKET VEHICLES

- Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090

SINGLE STAGE TO ORBIT VEHICLES

- STS 2000 - A reference airbreathing SSTO [AIAA PAPER 91-5013] p 126 A92-17811
- Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090

SKIN (STRUCTURAL MEMBER)

- Methodology for assessment of skin repairs on Airbus aircraft p 219 A92-14428
- Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 A92-18333
- Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 A92-23836
- Ageing airplane repair assessment program for Airbus A300 p 57 A92-30123

SKIN FRICTION

- Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 A92-22209
- Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 A92-27706
- Basic concepts on boundary layers p 44 A92-27707
- Boundary layer transition: Prediction, application to drag reduction p 44 A92-27711
- Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 A92-27714

SKYLARK ROCKET VEHICLE

- Skylark sounding rockets - Past and present p 286 A92-30108

SLENDER BODIES

- Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 A92-11967
- Asymmetric vortex flow over circular cones p 32 A92-13014
- An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 A92-13015

SLENDER WINGS

- Secondary separation from a slender wing p 6 A92-13448

SLIDING

- An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595

SLOPES

- Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800

SLOTS

- Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
- Turbulence control by intake [CERT-RF-67/5004-37] p 186 A92-12211

SLOTTED WIND TUNNELS

- Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675

SMALL PERTURBATION FLOW

- Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 A92-10989

SMALL SCIENTIFIC SATELLITES

- The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
- SMART STRUCTURES
- Active vibrations and noise control for turboprop application research program activities p 271 A92-32962

SMOKE

- The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998

SMOKE ABATEMENT

- Damping down the fires --- in civil transport aircraft p 53 A92-25075

SNEAK CIRCUIT ANALYSIS

- Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 A92-18630

SOCIAL FACTORS

- Domestic problems and aviator family support p 251 A92-13555
- Multi-cultural components and keys for European worldwide space programs p 122 A92-27008

SODAR

- Sodar wind speed profiles over forested boundary layer during the Hapex-Mobilhy campaign p 235 A92-17729

SOFTWARE ENGINEERING

- Requirements --- software development methods taking into account time and cost constraints p 255 A92-19382
- Ada --- design and use for aerospace software p 255 A92-19395
- Aerospace Software Engineering in France p 255 A92-19404
- Aerospace software engineering in the United Kingdom p 255 A92-19405
- Aerospace software in Sweden p 255 A92-19406
- From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368
- Computer software in civil aircraft p 256 A92-49302
- Tool supported software development experiences from the EFA project p 256 A92-12451
- Formal specification of satellite telemetry: A practical experience p 129 A92-12456
- Process/object-oriented Ada software design for an experimental helicopter p 257 A92-12461
- A practical experience of Ada for developing embedded software p 257 A92-12465
- Development of tactical decision aids p 90 A92-12532
- Avionics software evolution p 91 A92-14052
- Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 A92-14054
- Software product assurance requirements for ESA space systems [ESA-PSS-01-21-ISSUE-2] p 257 A92-14631
- Three-dimensional computer graphics in flow visualization p 189 A92-16227
- Visualization of results of mathematical simulations: The contribution of MCG p 190 A92-16236
- Mikado: A graphic program p 190 A92-16237
- FLOVIS (FLOW VISualizer) user manual, release 2.6, September 1990 p 190 A92-16238
- Space software is first of all software p 258 A92-20590
- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 A92-20600
- The integration and test of modern spacecraft control systems p 261 A92-20601
- Software management strategies and practices for space systems development p 258 A92-20610
- Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 A92-20611
- Simulation and control of large software projects p 258 A92-20615
- The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 A92-21847

SOFTWARE TOOLS

- The European ATC challenge p 58 A92-11877
- CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185
- ARINC and the avionics of commercial aircraft. II p 60 A92-37072
- Iberia's Aeronautical Mapping Application (ACA) p 60 A92-37073
- Computer software in civil aircraft p 256 A92-49302
- Test and integration concept for complex helicopter avionics systems p 90 A92-56292
- Tool supported software development experiences from the EFA project p 256 A92-12451
- Mixed approach towards modular avionics conflicting requirements p 91 A92-14051
- Avionics software evolution p 91 A92-14052
- Visualization of results of mathematical simulations: The contribution of MCG p 190 A92-16236
- Mikado: A graphic program p 190 A92-16237
- Development environment for digital manipulator simulators [PB91-222190] p 213 A92-16313
- Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 A92-18607
- System safety approach in manned Spacelab missions for control of hazards by software p 153 A92-18624
- RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 A92-18647
- Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) p 269 A92-20387
- [ONERA-RT-16/3641-PY] p 269 A92-20387
- Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCS p 136 A92-24493
- Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 A92-24721
- MBB-LAGRANGE: A general structural reliability and optimization structural system [MBB/FW321/S/PUB/467] p 220 A92-30423
- MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document p 50 A92-30713
- CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 A92-32835
- SOHO MISSION
- Design aspects of the attitude control system for the SOHO spacecraft p 135 A92-24433
- SOHO: A challenge in spacecraft thermoelastic design and verification p 139 A92-25859
- SOIL MOISTURE
- Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
- Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- SOILS
- Remote sensing of seasonal variations in albedo over southern Britain p 241 A92-33969
- SOL-GEL PROCESSES
- The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- SOLAR ACTIVITY
- Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808
- The upper atmosphere as sensed by satellite orbits p 230 A92-30638
- SOLAR ACTIVITY EFFECTS
- The sun, the solar wind, and cosmic rays p 285 A92-27131
- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 A92-23975
- LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 A92-27231
- SOLAR ARRAYS
- Power system performance prediction for the Hipparcos spacecraft p 141 A92-13155
- SOLAR CELLS
- Holographic dispersive concentrators for photovoltaic power generators p 142 A92-13236
- SOLAR COLLECTORS
- Holographic dispersive concentrators for photovoltaic power generators p 142 A92-13236
- SOLAR CYCLES
- A note on the interannual variability of the polar vortex in the Arctic p 233 A92-24659
- SOLAR FLARES
- The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 A92-27049

SOLAR GENERATORS

Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236

SOLAR ORBITS

On the radiant determination of meteors p 283 A92-18593

Use of natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644

SOLAR PLANETARY INTERACTIONS

The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415

SOLAR POWER SATELLITES

SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Ecole Supérieure d'Electricité, Gif-sur-Yvette, France, Aug. 27-30, 1991 p 226 A92-40401

SOLAR RADIATION

The sun, the solar wind, and cosmic rays p 285 A92-27131

Thermal control of spacecraft p 132 A92-33413

Low cost spacecraft attitude sensors p 140 N92-24458

Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755

SOLAR SAILS

Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430

SOLAR SENSORS

Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755

SOLAR TERRESTRIAL INTERACTIONS

Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275

The need of coordinated observations in space and from ground p 233 N92-26310

SOLAR WIND

The sun, the solar wind, and cosmic rays p 285 A92-27131

Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275

Antarctic studies of the cusp p 233 N92-26301

SOLAR X-RAYS

The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 N92-27049

SOLDERING

Dynamic solder management [AD-A250564] p 150 N92-29647

SOLDERS

Dynamic solder management [AD-A250564] p 150 N92-29647

SOLID FUELS

Introduction of the solid fuel combustion chamber project p 142 N92-22269

The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270

Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

Spin-offs of the solid fuel combustion chamber project p 143 N92-22275

SOLID PHASES

Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145

SOLID PROPELLANT COMBUSTION

Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467

Introduction of the solid fuel combustion chamber project p 142 N92-22269

The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270

Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

Spin-offs of the solid fuel combustion chamber project p 143 N92-22275

SOLID PROPELLANT ROCKET ENGINES

Skytark sounding rockets - Past and present p 266 A92-30108

Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467

Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750

SOLID ROCKET PROPELLANTS

Gosling --- British Defence System rocket motor p 286 A92-30101

SOLID SOLUTIONS

Melting and dissolving p 178 A92-46260

SOLID STATE LASERS

Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773

SOLID SURFACES

The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751

SOLID SUSPENSIONS

Behavior of a suspension in the presence of a potential vortex [ONERA, TP NO. 1991-140] p 163 A92-16114

SOLID-SOLID INTERFACES

The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083

SOLIDIFICATION

Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523

SOLITARY WAVES

Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 N92-21788

Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788

Applications of boundary integral methods to the study of steep free surface waves p 195 N92-23149

Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336

SONAR

An investigation of cold overflow over the Iceland/Faeroes Ridge [AD-A243084] p 242 N92-17169

SONDES

Seaborne lidar system p 224 N92-23389

SONIC ANEMOMETERS

Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 N92-29213

SONIC BOOMS

Environmental impact of a future supersonic transport aircraft [ONERA, TP NO. 1991-132] p 226 A92-16108

The sonic boom and problems related to supersonic flights of military aircraft [ONERA, TP NO. 1991-162] p 9 A92-16129

Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317

SOUND FIELDS

NATO CCMS aircraft noise study on receiver technology p 226 A92-39050

Noise from military airfields in the United Kingdom p 226 A92-39052

Study of noise generated by the impingement of a hot supersonic jet on an obstacle [ONERA, TP NO. 1992-33] p 267 A92-48594

Characterization of subcritical and supercritical jets by an acoustic imagery method [ONERA, TP NO. 1992-34] p 267 A92-48595

The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 N92-15938

SOUND GENERATORS

The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 N92-15938

SOUND PRESSURE

High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel [ONERA, TP NO. 1991-124] p 9 A92-16102

SOUND PROPAGATION

Computation of aircraft noise exposure using digitized topography data p 227 A92-39058

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773

SOUND TRANSMISSION

Acoustic isolation of layers p 265 A92-12345

Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086

Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197

Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 N92-32961

SOUND WAVES

Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363

Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045

Jet noise classical theory and experiments p 268 N92-10602

SOUNDING

Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary [ONERA-RTS-21/4365-AY-056A] p 76 N92-11009

ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679

SOUNDING ROCKETS

Skytark sounding rockets - Past and present p 286 A92-30108

Space activities in Italy p 121 A92-53457

Esrangle: Sounding rocket and balloon facility p 126 N92-20720

The Norwegian sounding rocket and balloon programme p 122 N92-24594

SOVIET SPACECRAFT

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

SPACE BASED RADAR

The design of spaceborne synthetic aperture radar [ETN-91-99886] p 156 N92-10114

Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668

ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679

SPACE COMMERCIALIZATION

Communication satellite system beyond the year 2000 [IAF PAPER 91-495] p 155 A92-18509

An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635

Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353

SPACE COMMUNICATION

Convergence of telecommunication technologies - Some legal aspects p 281 A92-36682

SPACE DEBRIS

Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764

'Space objects', 'astronauts', and related expressions p 281 A92-51854

Issues involved in defining outer space, space object and space debris p 282 A92-51856

Space debris - A proposal for its international legal regulation p 282 A92-51870

Protection of spacecraft against meteoroid/orbital debris impacts p 134 N92-23786

Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973

Limitation of space debris in geostationary transfer orbit p 125 N92-24774

SPACE ENVIRONMENT SIMULATION

Critical technologies: Spacecraft habitability, an update p 254 N92-27010

SPACE EXPLORATION

The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852

Use of natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644

The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510

The French space programme p 121 A92-53458

An example of space technological transfer in a small country [IAF PAPER 92-0178] p 282 A92-55636

Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353

International Space University: Experiences and observations during Summer 1989 p 275 N92-25786

SPACE FLIGHT

Operational aspects of spacecraft autonomy p 131 A92-24207

Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703

SPACE FLIGHT STRESS

Changes observed in lymphocyte behavior during gravitational unloading p 247 A92-52395

SPACE INDUSTRIALIZATION

European Space Agency - Achievements and perspectives p 121 A92-53459

An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635

Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413

SPACE LABORATORIES

Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508

Software management strategies and practices for space systems development p 258 N92-20610

SPACE LAW

Convergence of telecommunication technologies - Some legal aspects p 281 A92-36682

Space law and space technology - A common language p 281 A92-36695

'Space objects', 'astronauts', and related expressions p 281 A92-51854

- Issues involved in defining outer space, space object and space debris p 282 A92-51856
- Space debris - A proposal for its international legal regulation p 282 A92-51870
- SPACE MANUFACTURING**
- Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
- SPACE MECHANICS**
- Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
- SPACE MISSIONS**
- The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
- Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
- Multi-cultural components and keys for European worldwide space programs p 122 N92-27008
- SPACE NAVIGATION**
- Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
- High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
- Market directed thinking in a technological operation p 276 N92-23929
- Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
- GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 N92-24443
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- Management of navigation means failure in Hermes space vehicle p 136 N92-24467
- DLR research reports and communications [ETN-92-91391] p 287 N92-29218
- Activities report of the DLR [ETN-92-91392] p 287 N92-29219
- SPACE PLASMAS**
- Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
- An example of space technological transfer in a small country [IAF PAPER 92-0178] p 282 A92-55636
- SPACE PLATFORMS**
- Lite-Sat's for specific communication tasks p 156 N92-15232
- SPACE PROBES**
- Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- SPACE PROCESSING**
- Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
- SPACE PROGRAMS**
- Organizational impediments to the reduction of costs of space programmes [IAF PAPER 91-639] p 278 A92-20591
- Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings p 119 A92-32451
- Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827
- Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353
- Constraints and difficulties in implementations of RAMS assurance programmes [MBB-UK-0141-91-PUB] p 215 N92-17544
- Criticality management in space programs p 275 N92-18619
- Software management strategies and practices for space systems development p 258 N92-20610
- AGILE: An expert system for large space project management p 276 N92-20621
- Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
- Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
- The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
- The role of Belgium in Earth observation from space programs p 229 N92-25245
- Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 N92-25758
- SPACE RENDEZVOUS**
- Use of natural cometary orbits for spacecraft transfer to Cis-Orbit-Space [IAF PAPER 91-719] p 119 A92-20644
- SPACE SHUTTLE MISSIONS**
- Spectacular return for Columbia - Oldest Shuttle to make 13-day science mission p 128 A92-43596
- On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
- SPACE SHUTTLES**
- Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 N92-18632
- SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- SPACE STATION FREEDOM**
- Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560
- SPACE STATION PAYLOADS**
- Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings p 119 A92-32451
- SPACE STATION POLAR PLATFORMS**
- Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- SPACE SUITS**
- Problems experienced by man when constructing giant structures in space p 251 A92-40438
- SPACE TECHNOLOGY EXPERIMENTS**
- European Space Agency - Achievements and perspectives p 121 A92-53459
- An example of space technological transfer in a small country [IAF PAPER 92-0178] p 282 A92-55636
- SPACE TRANSPORTATION**
- Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 N92-29629
- Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics [MBB-FE-202-S-PUB-0464-A] p 48 N92-29648
- Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 N92-29649
- Aerothermodynamic challenges of the Saenger space-transportation system [MBB-FE-202-S-PUB-0462-A] p 129 N92-29680
- SPACE TRANSPORTATION SYSTEM**
- Aerothermodynamic challenges of the Saenger space-transportation system p 39 N92-15042
- SPACE VEHICLE CHECKOUT PROGRAM**
- The integration and test of modern spacecraft control systems p 261 N92-20601
- SPACE-TIME FUNCTIONS**
- A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256
- SPACEBORNE ASTRONOMY**
- The French space programme p 121 A92-53458
- The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma p 140 N92-10563
- SPACEBORNE EXPERIMENTS**
- Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings p 119 A92-32451
- Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412
- CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
- Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
- Spacecraft thermal control coatings p 151 N92-24829
- New results from FRECOPA analysis --- long duration exposure facility p 213 N92-27304
- Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834
- SPACECRAFT**
- 'Space objects', 'astronauts', and related expressions p 281 A92-51854
- Issues involved in defining outer space, space object and space debris p 282 A92-51856
- SPACECRAFT ANTENNAS**
- Italsat spacecraft multibeam payload antenna closed loop fine pointing system [IAF PAPER 91-509] p 129 A92-18519
- SPACECRAFT CABIN ATMOSPHERES**
- A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
- ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
- SPACECRAFT CHARGING**
- The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
- A method for determining the potential of a spacecraft p 131 A92-23433
- Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings [ISBN 2-85428-288-4] p 131 A92-27130
- SPACECRAFT COMMUNICATION**
- Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 N92-14268
- SPACECRAFT CONFIGURATIONS**
- Spacecraft structures p 132 A92-33410
- Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
- Hypersonic configurations in slow speed flight p 43 N92-24394
- The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- SPACECRAFT CONSTRUCTION MATERIALS**
- Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- MA alloys for aerospace applications --- Mechanical Alloying p 149 A92-26128
- Spacecraft structures p 132 A92-33410
- Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145
- The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
- Large thin composite thermostructural parts p 134 N92-23821
- SPACECRAFT CONTROL**
- Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
- A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
- Modelling and identification of flexible spacecraft p 131 A92-15409
- Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410
- Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133
- Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- Spacecraft electromagnetic compatibility engineering p 132 A92-33417
- Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600
- The integration and test of modern spacecraft control systems p 261 N92-20601
- Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 N92-20715
- Influence of microvibrations on spacecraft performances p 134 N92-23825
- Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
- Design aspects of the attitude control system for the SOHO spacecraft p 135 N92-24433
- The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- Management of navigation means failure in Hermes space vehicle p 136 N92-24467
- Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- The dynamics of the Cluster spacecraft p 137 N92-24510
- Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
- SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- SPACECRAFT DESIGN**
- Simulation of hypersonic flows on unstructured grids p 15 A92-31496
- Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
- Spacecraft systems engineering --- Book [ISBN 0-471-92794-5] p 120 A92-33401
- The space environment and its effects on spacecraft design p 120 A92-33403

- Spacecraft structures p 132 A92-33410
Thermal control of spacecraft p 132 A92-33413
Advanced spacecraft concepts using electrical propulsion
[AIAA PAPER 92-3513] p 132 A92-49046
Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
Large thin composite thermostructural parts p 134 N92-23821
SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859
Application of CFD tools in space projects --- computational fluid dynamics p 197 N92-25897
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- SPACECRAFT ELECTRONIC EQUIPMENT**
Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301
Spacecraft electromagnetic compatibility engineering p 132 A92-33417
- SPACECRAFT ENVIRONMENTS**
The space environment and its effects on spacecraft design p 120 A92-33403
Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300
Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 N92-28643
- SPACECRAFT GUIDANCE**
Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories p 129 A92-12473
Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
Management of navigation means failure in Hermes space vehicle p 136 N92-24467
- SPACECRAFT INSTRUMENTS**
CAPS-plasma spectrometer for the Cassini spacecraft p 140 N92-10565
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 N92-25758
- SPACECRAFT LANDING**
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679
- SPACECRAFT LAUNCHING**
Ground operations of a HTOL airbreathing launcher [IAF PAPER 91-217] p 125 A92-14708
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 N92-20715
Design evolution of the Ariane launching installations p 126 N92-20726
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
- SPACECRAFT MANEUVERS**
Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704
Atmospheric re-entry p 123 A92-33409
Apogee manoeuvre strategies for the Inmarsat-2 spacecraft [AAS PAPER 91-364] p 123 A92-43262
Reentry control of a low-lift maneuverable spacecraft [AIAA PAPER 92-4455] p 124 A92-55216
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
- SPACECRAFT MODELS**
Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834
- SPACECRAFT MOTION**
Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
Dynamics of spacecraft p 123 A92-33404
Spacecraft low frequency residual acceleration [IAF PAPER 92-0970] p 133 A92-57328
- SPACECRAFT PERFORMANCE**
Spacecraft systems engineering --- Book [ISBN 0-471-92794-5] p 120 A92-33401
- Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370
Influence of microvibrations on spacecraft performances p 134 N92-23825
- SPACECRAFT POWER SUPPLIES**
Different space electrochemical conversion and storage systems p 140 A92-40455
Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
ESA power standard p 141 N92-13174
Protection concepts used in spacecraft power systems p 142 N92-13176
Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 N92-26974
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- SPACECRAFT PROPULSION**
Advanced spacecraft concepts using electrical propulsion [AIAA PAPER 92-3513] p 132 A92-49046
Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208
Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 N92-14973
Aerothermodynamic challenges of the Saenger space-transportation system p 39 N92-15042
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 N92-29629
Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics [MBB-FE-202-S-PUB-0464-A] p 48 N92-29648
Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 N92-29649
- SPACECRAFT RECOVERY**
In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
The Hermes search and rescue operations in the open sea [AIAA PAPER 91-4099] p 128 A92-24357
- SPACECRAFT REENTRY**
Atmospheric re-entry p 123 A92-33409
Rotational temperature measurements in an arc jet p 177 A92-44395
New hypersonic test methods developed at ONERA - The P5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
- SPACECRAFT RELIABILITY**
Future technologies for space: New product assurance concepts p 153 N92-18650
- SPACECRAFT SHIELDING**
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
Protection of spacecraft against meteoroid/orbital debris impacts p 134 N92-23786
- SPACECRAFT STABILITY**
A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527
Determination of the structural weight of spacecraft p 135 N92-24387
- SPACECRAFT STRUCTURES**
A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development [IAF PAPER 91-288] p 130 A92-14714
Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547
Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
Large thin composite thermostructural parts p 134 N92-23821
Influence of microvibrations on spacecraft performances p 134 N92-23825
- SPACECRAFT TEMPERATURE**
Thermal control of spacecraft p 132 A92-33413
Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
Two-phase thermal technology for space application: Development status p 138 N92-25834
- Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848
A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881
- SPACECRAFT TRACKING**
Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 N92-14268
Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 N92-20715
- SPACECRAFT TRAJECTORIES**
Optimal finite-thrust spacecraft trajectories [AIAA PAPER 92-4510] p 124 A92-52080
Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- SPACECREWS**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
- SPACELAB**
System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624
- SPATIAL MARCHING**
Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations [ONERA, TP NO. 1991-131] p 9 A92-16107
Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231
Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232
- SPATIAL RESOLUTION**
Requirements for coordinated Cluster and ground-based observations of the cusp p 233 N92-26318
- SPECIFIC IMPULSE**
Propulsion system performance and integration for high Mach air breathing flight p 96 A92-46429
- SPECIFICATIONS**
ESA power standard p 141 N92-13174
Yacht sail aerodynamics. Part 3: Achievable jib/sail specification [ISBN-0-904947-17-3] p 52 N92-70513
- SPECTRAL BANDS**
Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88 p 242 A92-34878
- SPECTRAL LINE WIDTH**
Single alexandrite laser source for airborne DIATL system p 210 A92-51228
- SPECTRAL METHODS**
A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432
A spectral model for turbulent transport p 178 A92-45095
Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
Effects of spectrum variations on fatigue crack growth p 219 A92-57399
Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-90867] p 192 N92-19349
- SPECTRAL REFLECTANCE**
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
CO₂ laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
- SPECTRAL SIGNATURES**
A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
CO₂ laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535
- SPECTROMETERS**
The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma p 140 N92-10563
CAPS-plasma spectrometer for the Cassini spacecraft p 140 N92-10565
- SPECTRUM ANALYSIS**
Spectral analysis with a LDA in high speed flow p 209 A92-54339

SPHERES

The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751

SPHERICAL COORDINATES

Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 A92-21234

SPIN DYNAMICS

Spin-up in a semicircular cylinder p 184 A92-56123

SPIN STABILIZATION

Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655

Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547

Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155

SPLINE FUNCTIONS

Solving conservation laws with parabolic and cubic splines p 262 A92-27737

Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 A92-19151

SPLIT FLAPS

Construction of a numerical optimization method for the definition of hypersupported profiles [ONERA-RSF-43/1736-AY-146A] p 202 A92-28788

SPOILER SLOT ALERONS

Computer simulation of an unsteady flow around an airfoil with a spoiler p 19 A92-43167

SPOILERS

Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 A92-14995

Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds [ESDU-92002-SUPPL] p 51 A92-32782

SPORES

Long-term exposure of bacterial spores to space p 244 A92-27126

SPOT (FRENCH SATELLITE)

The French space program for earth observation p 222 A92-37154

SPRAY CHARACTERISTICS

Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 A92-32856

SPRAY NOZZLES

Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 A92-32856

SPRAYED COATINGS

Diagnostics of thermal spraying plasma jets p 213 A92-55403

STABILITY

The stability of graphite brushes at high velocity [ETN-91-90176] p 160 A92-12184

Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 A92-27946

STABILITY AUGMENTATION

Robust flight control systems - A parameter space design p 106 A92-50503

STABILITY DERIVATIVES

Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method p 105 A92-47779

Short time force measurement system p 114 A92-15001

Dynamic wind tunnel tests on control of forebody vortices with suction p 107 A92-18793

A review of scale effects on surfaces in unsteady motion p 46 A92-27962

STABILIZERS (FLUID DYNAMICS)

Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements [ONERA, TP NO. 1991-157] p 9 A92-16125

STAGNATION FLOW

A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574

Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868

Turbulent energy budgets in impinging zones p 17 A92-40081

STAGNATION POINT

Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 A92-22181

STANDARD DEVIATION

Variability of standard aircraft performance parameters [ESDU-91020] p 77 A92-17847

STANDARDIZATION

International standardisation of regulations for gust loading calculations p 68 A92-22473

The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 A92-14046

Avionics standardization in Europe p 91 A92-14050

Implications of interoperability and standardization for the industrial base p 92 A92-14057

STANDARDS

Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548

Military and civil software standards and guidelines for guidance and control p 257 A92-12452

ESA power standard p 141 A92-13174

Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 A92-14268

Re-engineing appears to offer best payback for young: Chapter 2 compliant aircraft [PNR-90848] p 98 A92-19939

STATIC PRESSURE

The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation [PNR-90791] p 194 A92-22099

STATIC STABILITY

Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 A92-29159

STATIC TESTS

Methodology for assessment of skin repairs on Airbus aircraft p 219 A92-14428

Proposal for the new fatigue management system for the AMX p 78 A92-18580

STATIONKEEPING

Benefits of electric propulsion for orbit injection of communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709

Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 A92-24504

STATISTICAL ANALYSIS

A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256

Unsteady three-dimensional Benard convection - Light-scattering, statistics and chaos p 168 A92-27379

Statistical methods applicable to analysis of aircraft performance data [ESDU-91017] p 77 A92-18096

Atmospheric turbulence spectra and correlation functions [NLR-TP-89217-U] p 234 A92-28689

STATISTICAL DISTRIBUTIONS

Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891

STATOR BLADES

Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548

STATORS

Supersonic stator-rotor interaction in a turbine stage [ONERA, TP NO. 1991-166] p 10 A92-16133

STEADY FLOW

High resolution schemes for steady flow computation p 161 A92-10036

Steady and unsteady 3D interactive boundary layers p 161 A92-10689

Topology of steady flows of low viscosity fluids p 162 A92-11219

Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649

Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822

Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139

Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737

A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429

Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384

Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240

A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617

Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973

Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 A92-12219

CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations [NLR-TR-88154-U] p 191 A92-18221

A linearised Riemann solver for Godunov-type methods [CRANFIELD-AERO-9116] p 265 A92-19924

Steady and unsteady 3D flow computation through a transonic turbine stage p 101 A92-27469

Unstructured grid methods for compressible flows p 201 A92-27676

STEADY STATE

On the Arnold stability criterion for steady-state flows of an ideal fluid p 165 A92-21506

STEAM FLOW

Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235

STEELS

Steels for aerospace applications p 149 A92-52983

STEERABLE ANTENNAS

Electronically steerable antenna for aircraft p 156 A92-15272

STELLAR ENVELOPES

The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171

STELLAR INTERIORS

Neutron superfluid spin-down and magnetic field decay in pulsars p 283 A92-13865

Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146

STELLAR MAGNETIC FIELDS

Neutron superfluid spin-down and magnetic field decay in pulsars p 283 A92-13865

Modelling stellar surface magnetic fields. I - Search strategies and uniqueness p 283 A92-14147

Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma [DE92-614464] p 284 A92-22653

STELLAR MASS EJECTION

Spherically symmetric, polytropic flow p 284 A92-20810

STELLAR MODELS

Modelling stellar surface magnetic fields. I - Search strategies and uniqueness p 283 A92-14147

STELLAR WINDS

The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171

STIFFNESS

Gust effects on a flexible aircraft p 68 A92-22474

Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 A92-18333

STIFFNESS MATRIX

A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866

STIRLING CYCLE

An overview of ESA cryocooler activities p 154 A92-25850

Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 A92-25851

The development of a range of low vibration mechanical cryocoolers for space application p 154 A92-25853

STIRLING ENGINES

Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779

STORMS (METEOROLOGY)

Lightning activity in microburst producing storm cells [ONERA, TP NO. 1991-98] p 235 A92-16080

STOVL AIRCRAFT

The selective bleed variable cycle engine --- aircraft propulsion [ASME PAPER 91-GT-388] p 93 A92-15720

Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549

International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings [ISBN 0-903409-68-2] p 3 A92-45302

Hot-gas reingestion - Engine response considerations p 95 A92-45317

Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318

A progress report on ASTOVL control concept studies under the VAAC programme p 104 A92-45319

ASTOVL engine control p 95 A92-45321

Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322

Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

STRAIN GAGES

Proposal for the new fatigue management system for the AMX p 78 A92-18580

Load monitoring of F-16 A/B aircraft of the RNLAf with a smart electronic device p 78 A92-18583

Aircraft tracking for structural fatigue p 79 A92-18584

The Operational Loads Monitoring System, OLMS p 79 A92-18586

STRAIN MEASUREMENT

The Operational Loads Monitoring System, OLMS
p 79 N92-18586

STRAPS

The RAF Institute of Aviation Medicine proposed helmet fitting/retention system
p 253 N92-19013

STRATIFIED FLOW

The enigmatic merging conditions of two-layer baroclinic vortices
p 162 A92-11225
Physical and computational modelling of stratified shear flows
[AERO-REPT-8909]
p 190 N92-17974

Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements
p 240 N92-26342

STRATOCUMULUS CLOUDS

Airborne lidar and radiometric observations of PBL- and low clouds
p 240 N92-31037

STRATOSPHERE

Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study
p 231 A92-52876

Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone
p 231 A92-54645
Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances
p 232 A92-55441

The stratospheric residual circulation as deduced from satellite data
p 232 N92-14498
Homogeneous and heterogeneous chemistry along air parcel trajectories
p 232 N92-14541

The concept of a long duration stratospheric balloon
p 43 N92-24645
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition
p 229 N92-29304

Aerosols and polar stratospheric clouds measurements during the EASOE campaign
p 229 N92-29306

Stratospheric warming
The coupling between radiation and dynamics in the stratosphere
p 238 A92-47733

The effects of resolution on diagnostic calculations of coupling between radiation and dynamics
p 238 A92-47734

Stratus clouds
Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements
p 240 N92-26342

Stream functions (fluids)
Adaptive streamline diffusion methods for compressible flow using conservation variables
p 172 A92-37535

Four-dimensional data assimilation - Comparison of variational and sequential algorithms
p 239 A92-51783

Streamlining
A simplified model for aerodynamic flows around streamlined models
p 6 A92-13816

A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations
p 172 A92-37504

Stress (biology)
Stress and error in aviation --- Book
p 249 A92-13015

The long-term psychological consequences of a major aircraft accident
p 249 A92-13020

Stress analysis
Stresses in rotating, orthotropic, circular, composite disks and plates
p 218 A92-51745

A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991
[FFA-TN-1991-24]
p 219 N92-12313

Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines
p 108 N92-23238

A dynamic subgrid-scale eddy viscosity model
p 203 N92-30649

Global/local interlaminar stress analysis of a grid-stiffened composite panel
[NASA-CR-190822]
p 221 N92-33139

Stress corrosion
New accelerated corrosion test methods
[MBB-Z-0406-91-PUB]
p 150 N92-32895

Stress corrosion cracking
Spacecraft sustained load fracture control
[NLR-TP-89163-U]
p 220 N92-28643

Stress distribution
Reynolds stress distribution downstream of a turbine cascade
p 17 A92-38861

On the approximate representation of velocity and shear stress distributions in low-speed boundary layers
[AERO-REPT-9012]
p 192 N92-18319

Finite element simulation of viscoelastic flow
p 205 N92-34038

STRESS INTENSITY FACTORS

Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material
[ETN-92-91301]
p 84 N92-24966

STRESS MEASUREMENT

The Operational Loads Monitoring System, OLMS
p 79 N92-18586

STRESS-STRAIN RELATIONSHIPS

Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317]
p 219 N92-14397

STRESSES

Stretched skin concept for the entry aerodynamic decelerator system of planetary probes
p 134 N92-23836

STRUCTURAL ANALYSIS

A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991
[FFA-TN-1991-24]
p 219 N92-12313

Integrated Design Analysis and Optimisation of Aircraft Structures
[AGARD-R-784]
p 83 N92-23227

The structural optimization system OPTSYS: Current status and applications
p 83 N92-23232

Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures
p 83 N92-23233

First approach to an integrated fin design
p 83 N92-23236

Structural optimization of aircraft practice and trends
p 83 N92-23239

Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-190353]
p 43 N92-25959

Winged launcher thermal design aspects
p 127 N92-27013

Integrated Design Analysis and Optimisation of Aircraft Structures
[AGARD-LS-186]
p 85 N92-28469

Fundamentals of structural optimisation
p 86 N92-28470

Structural optimization of aircraft
p 86 N92-28472

Multidisciplinary optimization of fiber composite aircraft structures
[MBB/FW321/S/PUB/476]
p 87 N92-30424

Continuous wavelet analysis of coherent structures
p 203 N92-30673

Definition of P.S.D.-design loads for nonlinear aircraft
[PB92-138619]
p 88 N92-70575

Structural design
The design challenge of a long endurance airship
[AIAA PAPER 92-1266]
p 69 A92-33344

Arbitrary blade section design based on viscous considerations - Background information
p 15 A92-36029

Aircraft structural design
p 72 A92-39304

Fatigue testing and tear down operations on Airbus A320 forward fuselage
p 78 N92-18579

First approach to an integrated fin design
p 83 N92-23236

Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines
p 108 N92-23238

Spacecraft Structures and Mechanical Testing, volume 1
[ESA-SP-321-VOL-1]
p 133 N92-23780

Concept for a European Space Station: Habitability, life support, and laboratory facilities
p 254 N92-27023

Mathematical optimization: A powerful tool for aircraft design
p 86 N92-28474

Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472]
p 87 N92-29650

MBB-LAGRANGE: A general structural reliability and optimization structural system
[MBB/FW321/S/PUB/467]
p 220 N92-30423

Multidisciplinary optimization of fiber composite aircraft structures
[MBB/FW321/S/PUB/476]
p 87 N92-30424

Vortex flow aerodynamics
[AGARD-AR-299]
p 50 N92-30947

Structural design criteria
Optimization of the flutter load by material orientation
p 217 A92-15222

International standardisation of regulations for gust loading calculations
p 68 A92-22473

STRUCTURAL ENGINEERING

Repair procedures for advanced composites for helicopters
p 4 A92-56277

Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472]
p 87 N92-29650

Repair procedures for advanced composites for helicopters
[MBB-UD-0606-91-PUB]
p 5 N92-29874

Structural failure
Mind that restyle --- failure analysis of aircraft composite structures
p 53 A92-13700

Aircraft fatigue management in the Royal Air Force
p 79 N92-18591

Fatigue management for the A-7P
p 79 N92-18593

A manufacturer's approach to ensure long term structural integrity
p 57 N92-30133

Structural reliability
A concept for the revisions of structural inspection schedules
p 215 N92-14431

Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating
p 78 N92-18574

Tornado structural fatigue life assessment of the German Air Force
p 79 N92-18592

Structural stability
Optimization of the flutter load by material orientation
p 217 A92-15222

General model of isolated helicopter blade for stability investigation
p 71 A92-35774

Determination of the structural weight of spacecraft
p 135 N92-24387

Structural vibration
Dynamic characterization and identification of nonlinear systems application to aeronautical structures
p 217 A92-11830

A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development
[IAF PAPER 91-288]
p 130 A92-14714

Transmission vibration monitoring - A single board computer architecture
p 89 A92-35765

Coupled propeller contributions to aircraft noise and vibration
p 266 A92-39085

Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell
p 267 A92-44197

Influence of microvibrations on spacecraft performances
p 134 N92-23825

Structural weight
Protection of spacecraft against meteoroid/orbital debris impacts
p 134 N92-23786

Determination of the structural weight of spacecraft
p 135 N92-24387

Subcritical flow
Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections
[AIAA PAPER 92-2653]
p 21 A92-45569

Characterization of subcritical and supercritical jets by an acoustic imagery method
[ONERA, TP NO. 1992-34]
p 267 A92-48595

Submarines
Air purification systems for submarines and their relevance to spacecraft
p 253 N92-25892

Submillimeter waves
Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project
p 209 N92-24363

Subsonic flow
A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines
[ASME PAPER 91-GT-392]
p 162 A92-15722

Spurious, zeroth-order entropy generation along a kinked wall
p 162 A92-15822

Computation of normal impinging jets in cross-flow and comparison with experiment
p 11 A92-22446

An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets
[AIAA PAPER 92-0323]
p 12 A92-25770

Compressibility effects in turbulent far wakes
p 18 A92-40140

Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines
p 175 A92-40172

Extrapolation procedures for the time-dependent Navier-Stokes equations
p 19 A92-41289

Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds
p 19 A92-43071

Numerical investigation into high-angle-of-attack leading-edge vortex flow
[AIAA PAPER 92-2600]
p 20 A92-45477

Two-point optimization of complete three-dimensional airplane configuration
[AIAA PAPER 92-2618]
p 73 A92-45491

Total losses in turbulent flows inside conical diffusers
p 23 A92-47782

Adaptive spectral methods with application to mixing layer computations
p 182 A92-52404

- The SR3 low density wind tunnel - Facility capabilities and research development
[AIAA PAPER 92-3972] p 112 A92-56798
- Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow
[REPT-90/59] p 29 N92-11982
- Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures
[DLR-FB-91-09] p 113 N92-12005
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
p 31 N92-13011
- Research on inverse methods and optimization in Italy
p 97 N92-13956
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations
[NLR-TR-88154-U] p 191 N92-18221
- Institute for experimental fluid mechanics: Results for 1990
[IB-222-90-A-46] p 191 N92-18244
- Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds
[NLR-TP-90029-U] p 41 N92-20498
- Unsteady Euler calculations in 3D internal aerodynamics
p 199 N92-27470
- Validation of non-orthogonal three-dimensional laminar flow predictions
p 199 N92-27476
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference
[NLR-TR-88072-U] p 49 N92-29884
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements
[ETN-92-91492] p 49 N92-29889
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
[NLR-TP-91117-U] p 51 N92-32732
- SUBSONIC SPEED**
Boundary layer transition: Prediction, application to drag reduction
p 44 N92-27711
- Jet aircraft noise at high subsonic flight Mach numbers
[DLR-FB-91-28] p 270 N92-29997
- An investigation into the interface between three closely spaced axis-symmetric bodies at subsonic speed
[CRANFIELD-AERO-9114] p 50 N92-31514
- SUBSONIC WIND TUNNELS**
Recent development of wind-tunnel test techniques at ONERA
[ONERA, TP NO. 1991-135] p 110 A92-16110
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model
[ESA-TT-1247] p 48 N92-29159
- Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions
[PB92-138577] p 118 N92-70574
- SUCTION**
The effects of wall suction on laminar-turbulent transition in three-dimensional flow
p 15 A92-36021
- Influence of suction through a slot on a turbulent boundary layer
p 18 A92-40127
- Characteristics of a boundary layer in a leading edge vortex
p 31 N92-13012
- Control of forebody vortices by suction at the nose of the RAE high incidence research model
p 32 N92-13022
- Dynamic wind tunnel tests on control of forebody vortices with suction
p 107 N92-18793
- SULFUR**
Sulfur emission, CCN, clouds and climate - A review
p 239 A92-52354
- SULFUR CHLORIDES**
Performances of 250 Amp-hr lithium/thionyl chloride cells
p 143 N92-27148
- SULFUR COMPOUNDS**
Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes
p 244 N92-26977
- SULFUR DIOXIDES**
Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances
p 232 A92-55441
- SULFURIC ACID**
Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances
p 232 A92-55441
- SURCHARGERS**
Radial inflow turbine study
[AD-A252783] p 214 N92-33538

SUPERCOMPUTERS

- Status and user characterization of parallel machines for digital simulation
p 260 A92-23046
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow
[ONERA, TP NO. 1991-196] p 255 A92-26355
- Parallel and vector aspects of a multigrid Navier-Stokes solver
[PB91-232868] p 260 N92-16645

SUPERCONDUCTING FILMS

- Interaction between moving flux lines and a two-dimensional electron gas
p 273 A92-11897
- Magnetic suspension using high temperature superconducting cores
p 161 N92-27789

SUPERCONDUCTORS

- Neutron superfluid spin-down and magnetic field decay in pulsars
p 283 A92-13865
- Exotic states in the cores of quantized vortices for superfluids and superconductors
[DE92-728466] p 206 N92-70151

SUPERCOOLING

- Melting and dissolving
p 178 A92-46260

SUPERCRITICAL AIRFOILS

- LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] p 33 N92-14004
- Comparison of Euler and full potential methods for unsteady transonic flow calculations
p 45 N92-27943
- Development and validation of a characteristic boundary condition for a cell-centered Euler method
[NLR-TP-90144-U] p 47 N92-28692

SUPERCRITICAL FLOW

- Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections
[AIAA PAPER 92-2653] p 21 A92-45569
- Characterization of subcritical and supercritical jets by an acoustic imagery method
[ONERA, TP NO. 1992-34] p 267 A92-48595

SUPERCRITICAL WINGS

- Inviscid drag prediction for transonic transport wings using a full-potential method
[NLR-TP-89365-U] p 41 N92-20473

SUPERFLUIDITY

- Neutron superfluid spin-down and magnetic field decay in pulsars
p 283 A92-13865
- Vortex nucleation in rotating superfluid He-3-B
p 271 N92-10476
- Superfluid vortex nucleation in He-3 flow
p 271 N92-10479
- Vortex motion in rotating superfluid He-3-B
[PB92-134162] p 194 N92-21763
- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3
[PB92-134147] p 269 N92-21773
- Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256] p 265 N92-23685
- Mutual friction in superfluid He-3: Effects of bound states in the vortex core
[PB92-142231] p 197 N92-26507
- Exotic states in the cores of quantized vortices for superfluids and superconductors
[DE92-728466] p 206 N92-70151

SUPERHEATING

- Melting and dissolving
p 178 A92-46260

SUPERSONIC AIRCRAFT

- The selective bleed variable cycle engine --- aircraft propulsion
[ASME PAPER 91-GT-388] p 93 A92-15720
- Four decades of transonic fighter design
p 68 A92-20203
- The environmental challenges for the next supersonic aircraft
[PNR-90782] p 228 N92-20928

SUPERSONIC BOUNDARY LAYERS

- Performance of turbulence models to predict supersonic boundary layer flows
p 16 A92-37553

SUPERSONIC COMBUSTION RAMJET ENGINES

- French research and technology program on advanced hypersonic propulsion
[AIAA PAPER 91-5003] p 94 A92-31683

SUPERSONIC COMPRESSORS

- Quasi-three-dimensional characteristics method for a supersonic compressor rotor
[ASME PAPER 91-GT-81] p 7 A92-15549
- Supersonic flow in compression stages and inlets
p 43 N92-24395

SUPERSONIC FLIGHT

- Prediction of generalized aerodynamic forces following linearized supersonic theory
[ONERA, TP NO. 1991-114] p 9 A92-16093
- Thermomechanical model of the linkage between an I.R. window and the housing device
[ONERA, TP NO. 1991-158] p 131 A92-16126

- The sonic boom and problems related to supersonic flights of military aircraft
[ONERA, TP NO. 1991-162] p 9 A92-16129
- The turbo-ramjet Griffon
p 286 A92-41820
- Evolution of ASTOVL aircraft design
p 72 A92-45311

- FALKE and COBRA technology development in aerodynamics and aerothermodynamics
p 37 N92-15017

- Advanced tactical fighter engine
[ETN-92-90840] p 97 N92-18728

- ASTOVL engine control
[PNR-90808] p 100 N92-27040

SUPERSONIC FLOW

- Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes
[ASME PAPER 91-GT-312] p 8 A92-15689

- Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations
[ONERA, TP NO. 1991-131] p 9 A92-16107

- Aerosol behavior in supersonic flows
[ONERA, TP NO. 1991-155] p 206 A92-16124
- Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines
[ONERA, TP NO. 1991-170] p 110 A92-16135

- Noise-driven flow
p 10 A92-18680
- Linear panel flutter of an elliptic cylindrical shell
p 218 A92-12126

- A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion
p 12 A92-25098

- An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets
[AIAA PAPER 92-0323] p 12 A92-25770

- A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55
p 14 A92-28006

- Experimental investigation of supersonic flow over two cavities in tandem
p 15 A92-36830
- Compressibility effects in turbulent far wakes
p 18 A92-40140

- The effects of viscosity and diffusion on a supersonic mixing layer
p 18 A92-40143
- Reactive mixing layer between pressure reflecting boundaries
p 95 A92-40144

- Basic experiment on a supersonic vortex flow around a missile body
p 19 A92-41545
- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations
[AIAA PAPER 92-2613] p 20 A92-45487

- Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method
p 105 A92-47779

- A hot wire method for measuring turbulence in transonic or supersonic heated flows
p 207 A92-50037
- A general explicit or semi-explicit algorithm for compressible and incompressible flows
p 25 A92-52682

- Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95
[AIAA PAPER 92-3956] p 112 A92-56784

- The SR3 low density wind tunnel - Facility capabilities and research development
[AIAA PAPER 92-3972] p 112 A92-56798

- Numerical resolution of three dimensional Euler equations in totally unstructured mesh
[CERT-RF-1/3369-00/DERI-GAN] p 28 N92-10988

- Compression ramp in rarefied gas
[RC-90-08] p 29 N92-11978
- Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed
p 34 N92-14987

- Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations
p 35 N92-14989

- Numerical solution of discontinuity dynamics: Two dimensional supersonic flows
p 36 N92-14997
- Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography
p 114 N92-15003

- Efficient solution of three-dimensional viscous hypersonic flows
p 37 N92-15007
- Testing high order shock-capturing schemes in 2D super- and hypersonic flows
p 38 N92-15023

- Computation of aerodynamic coefficients on Hermes-Ariane5 configuration
p 38 N92-15040
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations
[NLR-TR-88154-U] p 191 N92-18221

- Marching with the parabolized Navier-Stokes equations.
Problem 1: Numerical study of hypersonic viscous cone flow
[AERO-REPT-9007] p 40 N92-18231
Supersonic flow in compression stages and inlets
p 43 N92-24395
Nonequilibrium 3D flows of air through inlets
p 200 N92-27487
Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements
[ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- SUPERSONIC FLUTTER**
Optimization of the flutter load by material orientation
p 217 A92-15222
- SUPERSONIC INLETS**
Air intakes for high speed vehicles
[AGARD-AR-270] p 41 N92-20797
- SUPERSONIC JET FLOW**
Study of noise generated by the impingement of a hot supersonic jet on an obstacle
[ONERA, TP NO. 1992-33] p 267 A92-48594
- SUPERSONIC SPEED**
Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds
[ESDU-91004] p 28 N92-11967
Lift-curve slope of wing-body combinations
[ESDU-91007] p 28 N92-11968
Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack
p 39 N92-15971
Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds
[ESDU-91042] p 84 N92-24009
- SUPERSONIC TRANSPORTS**
Environmental impact of a future supersonic transport aircraft
[ONERA, TP NO. 1991-132] p 226 A92-16108
Supersonic transport in the 21st century
p 2 A92-26793
- SUPERSONIC TURBINES**
Supersonic stator-rotor interaction in a turbine stage
[ONERA, TP NO. 1991-166] p 10 A92-16133
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade
[ASME PAPER 91-GT-221] p 179 A92-46825
Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver
p 23 A92-48207
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
p 101 N92-27466
Steady and unsteady 3D flow computation through a transonic turbine stage
p 101 N92-27469
- SUPPORT INTERFERENCE**
Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model
[ESA-TT-1247] p 48 N92-29159
- SUPPORT SYSTEMS**
The COMPAS system in the ATC environment
[DLR-MITT-91-08] p 62 N92-19041
Design principles of automation aids for ATC approach control
p 62 N92-19042
The role of planning systems in future air traffic management
p 64 N92-19050
The role of simulation for the study of APIS (piloting support by synthetic imagery)
p 116 N92-28544
- SURFACE GEOMETRY**
Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface
p 263 A92-54574
- SURFACE PROPERTIES**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft
p 222 A92-35034
The stability of graphite brushes at high velocity
[ETN-91-90176] p 160 N92-12184
Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] p 147 N92-14141
A boundary integral approach in primitive variables for free surface flows
p 187 N92-14304
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft
p 285 N92-25679
- SURFACE REACTIONS**
Drag coefficients with applications to satellite orbits
p 133 N92-11069
- SURFACE ROUGHNESS**
The icing of the elevator of the DLR icing research aircraft of Do 28 type
[DLR-MITT-91-12] p 58 N92-31813
- SURFACE ROUGHNESS EFFECTS**
The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer
p 235 A92-17730
- Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique
p 236 A92-25198
- SURFACE TEMPERATURE**
Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence
[ONERA, TP NO. 1991-94] p 206 A92-16077
Spectral emissivity variations observed in airborne surface temperature measurements
p 221 A92-17124
Diagnostics of thermal spraying plasma jets
p 213 A92-55403
TIMS calibration correction by comparison with PRT5
p 223 N92-11412
Using the radiative surface temperature in energy budget studies over plant canopies
p 223 N92-11506
Hypersonic flow past radiation-cooled surfaces
[MBB-FE-202-S-PUB-0468-A] p 49 N92-29713
- SURFACE WAVES**
Applications of boundary integral methods to the study of steep free surface waves
p 195 N92-23149
- SURGES**
Whole aircraft lightning indirect effects evaluation using low level injection techniques
p 68 A92-20134
- SURVEILLANCE RADAR**
Computation of aircraft geometric height under radar surveillance
p 61 A92-40239
- SURVIVAL EQUIPMENT**
Learning from aircraft accidents and incidents
p 54 A92-39310
- SUSPENSION SYSTEMS (VEHICLES)**
The structural optimization system OPTSYS: Current status and applications
p 83 N92-23232
- SWEDEN**
Esrang: Sounding rocket and balloon facility
p 126 N92-20720
- SWEDISH SPACE PROGRAM**
Sweden and the space plane - A small country with high ambition
[AIAA PAPER 91-0505] p 119 A92-17804
Swedish user support for Columbus
p 120 A92-32469
The Swedish space program
p 121 A92-53452
- SWEEP FREQUENCY**
Whole aircraft lightning indirect effects evaluation using low level injection techniques
p 68 A92-20134
- SWEEP WINGS**
Characteristics of a boundary layer in a leading edge vortex
p 31 N92-13012
An experimental investigation of vortex flaps on a canard combat-aircraft configuration
p 33 N92-13023
A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows
[ESDU-91021] p 39 N92-15970
Boundary layer transition: Prediction, application to drag reduction
p 44 N92-27711
Comparison of Euler and full potential methods for unsteady transonic flow calculations
p 45 N92-27943
- SWEEPBACK TAIL SURFACES**
Effect of twin fins on isolated tailplane lift-curve slope
[ESDU-91009] p 28 N92-11969
- SWEEPBACK WINGS**
Instantaneous visualization of surface flows
p 207 A92-44327
- SWIRLING**
Internal flow modelling of vortex throttles
p 168 A92-27385
Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study
p 178 A92-45603
Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames
[ETN-92-92103] p 205 N92-33916
- SYMBOLIC PROGRAMMING**
Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories
[IAF PAPER 91-059] p 129 A92-12473
- SYMMETRICAL BODIES**
Numerical solutions for uniform flow around symmetrical bodies using panel methods
[AERO-REPT-9014] p 192 N92-18320
Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow
[ETN-92-91489] p 202 N92-29926
- SYMPHONIE SATELLITES**
The technical evolution of ground flight dynamics system utilized for spacecraft operations
[IAF PAPER 92-0546] p 125 A92-55850
- SYNCHRONOUS SATELLITES**
Benefits of electric propulsion for orbit injection of communication spacecraft
[AIAA PAPER 92-1955] p 140 A92-31709
Approach to the evaluation of interferences between co-located geostationary spacecraft
p 137 N92-24721
Photographic observations of the co-located spacecraft at 19 deg West
p 138 N92-24724
- Estimation of attitude thruster activity of spacecraft on Sun acquisition mode
p 138 N92-24755
- SYNCOPE**
Pulmonary effects of high-G and positive pressure breathing
p 248 N92-18978
- SYNOPTIC METEOROLOGY**
On the relation between total ozone and meteorology
p 236 A92-27796
A most beautiful polar low - A case study of a polar low development in the Bear Island region
p 237 A92-32487
A comparison of satellite sounding data and aircraft measurements within a mature polar low
p 237 A92-32489
- SYNTHETIC APERTURE RADAR**
Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88
p 242 A92-34878
First results from the Netherlands SAR testbed 'PHARS' --- Phased array universal SAR
p 221 A92-34903
Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations
p 242 A92-34943
A SAR processor for a GIS environment
p 155 A92-34980
Simulations of SAR imaging of ship wakes, comparing different wind growth rate models
p 242 A92-35025
Multi-parameter airborne SAR experiments at an Alpine test site
p 222 A92-35173
Measurements of ocean wave spectra with the RESSAC airborne radar
p 89 A92-35256
The UK element of the Maestro-1 SAR campaign --- ESA and NASA program for earth remote sensing
p 223 A92-44167
Radiometric calibration of an airborne C-band synthetic aperture radar
p 62 A92-53731
The design of spaceborne synthetic aperture radar
[ETN-91-99986] p 156 N92-10114
AGARD highlights 91/2
[ISBN-92-835-0634-0] p 286 N92-13916
- SYSTEM EFFECTIVENESS**
The requirements and management of quality audits and reviews
[PNR-90840] p 275 N92-20458
- SYSTEM IDENTIFICATION**
Dynamic characterization and identification of nonlinear systems application to aeronautical structures
p 217 A92-11830
Modelling and identification of flexible spacecraft
p 131 A92-15409
Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures
p 131 A92-15410
Spacecraft in-orbit identification using eigensystem realization methods
p 132 A92-28133
Rotorcraft system identification
[AGARD-AR-280] p 75 N92-11001
Model parameter identification techniques for flight flutter testing
[AERO-REPT-9105] p 107 N92-18294
The role of systems simulation for the development and qualification of ATTAS
p 117 N92-28548
- SYSTEMS ANALYSIS**
Quality assurance of safety and risk analysis
p 215 N92-18629
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies
p 160 N92-18630
Modeling and simulation of complex mechanical systems for space applications
p 135 N92-24389
Fuzzy guidance system evaluation
p 259 N92-27903
- SYSTEMS ENGINEERING**
Test Engineering Language for Avionic Systems
p 89 A92-35763
British Airways Airbus A320 pilots' autothrust survey
[SAE PAPER 912225] p 54 A92-40023
A computerized flight inspection system --- for testing of basic air navigation ground facilities
p 61 A92-43881
The design of spaceborne synthetic aperture radar
[ETN-91-99986] p 156 N92-10114
The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma
p 140 N92-10563
A systematic formulation, as an approach to air traffic
[MBB-Z-0371-91-PUB] p 62 N92-10996
AGARD highlights 91/2
[ISBN-92-835-0634-0] p 286 N92-13916
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment
p 91 N92-14054
A product assurance engineering concept for complex space systems
p 216 N92-18645
RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems
p 258 N92-18647

- Future technologies for space: New product assurance concepts p 153 N92-18650
- Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
- Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926
- The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 N92-21847
- Sensor compatibility/optimal sensor combinations p 224 N92-23403
- Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
- SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859
- Winged launcher thermal design aspects p 127 N92-27013
- Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-LS-186] p 85 N92-28469
- Concurrent engineering p 260 N92-30952
- SYSTEMS INTEGRATION**
- Is the avionics system of the Hermes Spaceplane centralized or decentralized? p 139 A92-49258
- Test and integration concept for complex helicopter avionics systems p 90 A92-56292
- Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008
- Fixed wing night attack EO integration and sensor fusion p 253 N92-19009
- Extension of the Frankfurt COMPAS for general application p 63 N92-19048
- The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049
- Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233
- First approach to an integrated fin design p 83 N92-23236
- Structural optimization of aircraft practice and trends p 83 N92-23239
- Preconsiderations on aircraft integration p 224 N92-23402
- Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464
- Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 N92-30941
- Integrated Target Acquisition and Fire Control Systems [AGARD-CP-500] p 92 N92-32437
- SYSTEMS MANAGEMENT**
- AGARD highlights 91/2 [ISBN-92-835-0634-0] p 286 N92-13916
- SYSTEMS SIMULATION**
- Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- Testing of an experimental FMS p 85 N92-25596
- Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977
- The role of systems simulation for the development and qualification of ATAS p 117 N92-28548
- SYSTEMS STABILITY**
- Some problems of the stability of a system of three vortices p 182 A92-51893
- T**
- TACTICS**
- Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 N92-27888
- TAIL ASSEMBLIES**
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- Effect of twin fins on isolated tailplane lift-curve slope [ESDU-91009] p 28 N92-11969
- Compression ramp in rarefied gas [RC-90-08] p 29 N92-11978
- TAIL ROTORS**
- Tail rotor aerodynamic features recorded in flight p 70 A92-35752
- TAKEOFF**
- Aircraft control for take-off in windshear p 104 A92-36990
- Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- Variability of standard aircraft performance parameters [ESDU-91020] p 77 N92-17847

- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
- Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment p 56 N92-21697
- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Some implications for advanced STOVL operation from invincible class ships p 82 N92-21971
- TANKER AIRCRAFT**
- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- TANKS (CONTAINERS)**
- Spin-up in a semicircular cylinder p 184 A92-56123
- On the analysis of liquid filled free-free tanks p 196 N92-23843
- A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 N92-23846
- Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834
- TAPE RECORDERS**
- Advanced method for single event aircraft noise analysis p 266 A92-39060
- TARGET ACQUISITION**
- Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468
- Use of target spectrum for detection enhancement and identification p 157 N92-19155
- Integrated Target Acquisition and Fire Control Systems [AGARD-CP-500] p 92 N92-32437
- TARGET RECOGNITION**
- Use of target spectrum for detection enhancement and identification p 157 N92-19155
- TARGETS**
- Optimal guidance anticipating missile performance p 128 N92-27902
- TAXIING**
- Testing concept of a movement area guidance p 65 N92-25597
- TAYLOR INSTABILITY**
- Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
- Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
- Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
- Modelling compressible turbulent mixing p 178 A92-45094
- TAYLOR SERIES**
- An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- TECHNOLOGICAL FORECASTING**
- Tomorrow's cockpit displays p 88 A92-13699
- Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- Organizational impediments to the reduction of costs of space programmes [IAF PAPER 91-639] p 278 A92-20591
- Supersonic transport in the 21st century p 2 A92-26793
- British Aerospace Hawk into the 1990s p 73 A92-50009
- Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
- Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
- TECHNOLOGIES**
- Space law and space technology - A common language p 281 A92-36695
- The impact of aircraft noise control technology [PNR-90846] p 269 N92-20461
- Market directed thinking in a technological operation p 276 N92-23929
- TECHNOLOGY ASSESSMENT**
- High costs force avionics links p 88- A92-22000
- Anglo-American avionics p 2 A92-25575
- Productivity and quality in the Modane and Fauga wind tunnels - Prospects for the 90s [ONERA, TP NO. 1991-203] p 111 A92-26360
- The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
- Why composites wait in the wings p 144 A92-35475
- GPS/GLONASS user systems in Sweden p 61 A92-38384
- Shear progress --- wind shear handling and recognition technologies for aviation p 3 A92-40880
- Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304

- Eighty years of aerospace technique through ATMA bulletins [ETN-91-90097] p 286 N92-11963
- Biotechnology in a global economy. Volume 2, part 1: Contractor documents [PB91-212068] p 228 N92-13494
- Lite-Sat's for specific communication tasks p 156 N92-15232
- Computer Graphics and Flow Visualization in Computational Fluid Dynamics [VKI-LS-1991-07] p 189 N92-16226
- Future technologies for space: New product assurance concepts p 153 N92-18650
- Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
- European industrial capabilities to provide meteorological space systems p 228 N92-25238
- The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666
- An overview of ESA cryocooler activities p 154 N92-25850
- Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870
- Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 N92-29629
- The Eurofar program: An European overview on advanced VTOL civil transportation system [MBB-UD-0611-91-PUB] p 58 N92-30418
- Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675
- Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315] p 118 N92-30769
- Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742
- TECHNOLOGY TRANSFER**
- Successful transfer of technology from a research and development laboratory to an Aerospace production unit p 4 A92-51808
- An example of space technological transfer in a small country [IAF PAPER 92-0178] p 282 A92-55636
- Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659
- Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661
- Transfers of technology: International negotiations and work in progress p 278 N92-18665
- Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120
- Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- TECHNOLOGY UTILIZATION**
- The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
- Communication satellite system beyond the year 2000 [IAF PAPER 91-495] p 155 A92-18509
- Convergence of telecommunication technologies - Some legal aspects p 281 A92-36682
- Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779
- A research and technology program for the benefit of the Ariane family [IAF PAPER 92-0873] p 127 A92-57262
- Applications of ultra-high vacuum technique to surface and near-surface studies [ETN-92-90454] p 147 N92-14141
- Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961
- Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
- Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 N92-25758
- Control concepts for active magnetic bearings p 214 N92-27743
- Activities report of the Netherlands Remote Sensing Board (with abridged version) [ETN-92-91352] p 225 N92-29688
- Concurrent engineering p 260 N92-30952
- The USOCs, the resources management, and their links with telepresence p 276 N92-33466
- TELECOMMUNICATION**
- Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659

TELEMETRY

Formal specification of satellite telemetry: A practical experience p 129 N92-12456

TELEOPERATORS

Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189
The USOCs, the resources management, and their links with telepresence p 276 N92-33466

TELEPHONES

Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 N92-30941

TELEPHONY

Implementation of Inmarsat mobile satcom systems p 157 N92-24073

TELEROBOTICS

Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704

TEMPERATURE

The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349

TEMPERATURE CONTROL

Thermal control of spacecraft p 132 A92-33413
Spacecraft thermal control coatings p 151 N92-24829

Fourth European Symposium on Space Environmental Control Systems, Volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828

Two-phase thermal technology for space application: Development status p 138 N92-25834

A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841

SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859

The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986

Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027

TEMPERATURE DISTRIBUTION

Application of infrared thermography to thermal flux measurement in wind tunnels p 112 N92-11020

Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 N92-11288

Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482

TEMPERATURE EFFECTS

On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory p 184 A92-55479

Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166

TEMPERATURE GRADIENTS

Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge p 232 N92-13512

Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978

TEMPERATURE MEASUREMENT

Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence [ONERA, TP NO. 1991-94] p 206 A92-16077

Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124

Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430

A new thermometric instrument for airborne measurements in clouds p 88 A92-24918

CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376

Rotational temperature measurements in an arc jet p 177 A92-44395

Rotational temperature measurements of N₂(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982

Application of infrared thermography to thermal flux measurement in wind tunnels p 112 N92-11020

Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003

TEMPERATURE MEASURING INSTRUMENTS

Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

TEMPERATURE PROFILES

Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

An investigation of cold overflow over the Iceland/Faeroes Ridge [AD-A243084] p 242 N92-17169

TEMPERATURE SENSORS

Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 N92-11288

TEMPORAL RESOLUTION

Requirements for coordinated Cluster and ground-based observations of the cusp p 233 N92-26318

TENSILE DEFORMATION

Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP p 219 N92-14420

TENSOR ANALYSIS

A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 N92-14321

TERMINAL FACILITIES

Airport terminals p 110 A92-21125

Terminal area traffic management p 61 A92-50122

TERMINAL GUIDANCE

Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958

Approach and landing guidance p 65 N92-21960

TERMINOLOGY

'Space objects', 'astronauts', and related expressions p 281 A92-51854

An attempt to unify space terminology - The Multilingual Terminology Data Base [IAF PAPER 92-0343] p 277 A92-55758

How to circulate official terminology [IAF PAPER 92-0346] p 277 A92-55761

Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762

Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764

Some new definitions for the Multilingual Terminology Data Base [IAF PAPER 92-0359] p 277 A92-55766

Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773

TERRAIN ANALYSIS

Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173

Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529

TERRAIN FOLLOWING AIRCRAFT

Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529

TEST FACILITIES

Heavy metal --- fighter aircraft test rigs p 110 A92-18100

Recent developments at the Shoeburyness STOVL test facility p 111 A92-45314

Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

An overview of the planned aerospace test facilities at Capua, Italy [AIAA PAPER 92-3944] p 112 A92-56773

Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809

Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189

Aerospace technology: Technical data and information on foreign test facilities [GAO/NSIAD-90-71FS] p 113 N92-13076

Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089

The Goldstein Engineering Research Laboratory [AERO-REPT-8906] p 5 N92-18322

Recent developments at the Shoeburyness (England) STOVL Test Facility [PNR-90806] p 115 N92-22096

Introduction and execution of flight tests at the DLR p 85 N92-25594

Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007

LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983

TEST VEHICLES

The German Hypersonics Technology Programme - Status report 1992 [IAF PAPER 92-0867] p 127 A92-57258

TETHERED SATELLITES

Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606

Equilibrium configurations in a tethered atmospheric mission [AAS PAPER 91-543] p 124 A92-43391

Fluid dynamic forces on tethered satellite systems p 124 A92-52738

TETRAHEDRONS

Cluster: Fuel optimum spacecraft formation control p 122 N92-24777

THEMATIC MAPPERS (LANDSAT)

Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633

THEMATIC MAPPING

Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104

THEOREMS

On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973

Sydney Goldstein FRS Hon FRAeS: An appreciation [AERO-REPT-8903] p 286 N92-17928

THERMAL ANALYSIS

Use of composite materials for aeronautical structure p 143 A92-15303

Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848

A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881

Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 N92-25959

Winged launcher thermal design aspects p 127 N92-27013

THERMAL CONTROL COATINGS

Spacecraft thermal control coatings p 151 N92-24829

Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

THERMAL CYCLING TESTS

High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796

Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118

THERMAL EMISSION

Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124

THERMAL FATIGUE

High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796

THERMAL INSULATION

The concept of a long duration stratospheric balloon p 43 N92-24645

THERMAL PLASMAS

Diagnostics of thermal spraying plasma jets p 213 A92-55403

THERMAL PROTECTION

The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009

Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027

Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996

Winged launcher thermal design aspects p 127 N92-27013

Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422

THERMAL RADIATION

Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430

An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222

TIMS calibration correction by comparison with PRT5 p 223 N92-11412

Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506

Passive optical and IR sensors [MBB-UH-HE512] p 224 N92-23392

Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848

THERMAL RESISTANCE

- Large thin composite thermostructural parts
p 134 N92-23821

THERMAL STABILITY

- On inertial waves in the earth's fluid core
p 231 A92-37905

THERMAL STRESSES

- Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles
[ONERA, TP NO. 1992-31] p 218 A92-48592

THERMOCHEMISTRY

- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] p 187 N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] p 188 N92-14326

THERMOCINES

- Modelling of interfacial and thermocline waves
[AERO-REPT-9006] p 243 N92-18089
Modelling of interfacial and thermocline waves
[AERO-REPT-9011] p 243 N92-18234
Modelling of interfacial and thermocline waves
[AERO-REPT-9004] p 243 N92-18340

THERMODYNAMIC CYCLES

- Practical considerations in designing the engine cycle
p 102 N92-28460

THERMODYNAMIC EQUILIBRIUM

- Linear acoustics in gas mixtures with rate processes
p 269 N92-15013
Hypersonic viscous shock layer in thermochemical nonequilibrium
p 37 N92-15014
The concept of a long duration stratospheric balloon
p 43 N92-24645

THERMODYNAMIC PROPERTIES

- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility
p 186 N92-12203
Numerical grid generation using a variational method
[MBB-FE211-S-PUB-447] p 190 N92-17312

THERMODYNAMICS

- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics
p 287 N92-26086
Steady and transient performance calculation method for prediction, analysis, and identification
p 102 N92-28461

THERMOELASTICITY

- SOHO: A challenge in spacecraft thermoelastic design and verification
p 139 N92-25859

THERMOGRAPHY

- Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence
[ONERA, TP NO. 1991-94] p 206 A92-16077
Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography
p 206 A92-21450
Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography
p 167 A92-24430
Indirect measurements of convective flow by IR thermography
[ONERA, TP NO. 1992-46] p 207 A92-48607
Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique
p 26 A92-54308
Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography
p 208 A92-54321
Application of infrared thermography to thermal flux measurement in wind tunnels
[AAAF-NT-89-12] p 112 N92-11020
Thermographic gust wind tunnel measurements
[ONERA-RF-31/3409-PY] p 29 N92-11972
Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique
p 35 N92-14994
Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography
p 114 N92-15003
Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests
[ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
- THERMOLUMINESCENCE**
LDEF: Dosimetric measurement results (AO 138-7 experiment)
p 271 N92-27231
- THERMOPLASTIC RESINS**
Hot melt joints for carbon fibre reinforced composites
p 213 A92-54870
Environmental resistance of amorphous bonded thermoplastic joints
p 146 N92-33053
- THERMOSETTING RESINS**
State of composite material structure control in situ
p 215 A92-54862

- CFRP stiffened panels under compression
p 146 N92-33044

THERMOSPHERE

- Long-lived polar thermospheric vortices - A combined radar and optical study
p 230 A92-10629
The upper atmosphere as sensed by satellite orbits
p 230 A92-30638

THERMOSTATS

- A heat switch for space cryocooler applications
p 160 N92-25852

THIN AIRFOILS

- A note on the Kutta condition in Glauert's solution of the thin aerofoil problem
p 16 A92-37933
A method for solving the 2-dimensional potential flow around thin curved profiles
p 176 A92-43068

THIN BODIES

- The multiparameter method of a boundary layer on thin bodies of revolution
p 165 A92-21613

THIN WALLED SHELLS

- Acoustic isolation of layers
p 265 A92-12345

THIN WINGS

- System for transonic wing design with geometric constraints based on an inverse method
[PB92-138692] p 53 N92-70576

THREE AXIS STABILIZATION

- Relegation of the proper rotation in attitude dynamics of a spacecraft
p 138 N92-24728

THREE DIMENSIONAL BODIES

- Incompressible steady aerodynamics using a standard finite element code
p 11 A92-20218
Navier-Stokes computation over a three-dimensional ramp
[ONERA, TP NO. 1992-55] p 181 A92-48616
Effect of viscous damping on the response of floating bodies
p 187 N92-14303

THREE DIMENSIONAL BOUNDARY LAYER

- Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices
p 163 A92-16043
Direct and large-eddy simulations of transition in the compressible boundary layer
p 170 A92-31196
The effects of wall suction on laminar-turbulent transition in three-dimensional flow
p 15 A92-36021
The inviscid compressible Goertler problem in three-dimensional boundary layers
p 22 A92-46441
An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers
p 180 A92-48206
Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface
p 263 A92-54574
The initial boundary-layer flow past a translating and spinning rotational symmetric body
p 185 A92-57449
Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region
[ESA-TT-1237] p 205 N92-33996

THREE DIMENSIONAL FLOW

- Steady and unsteady 3D interactive boundary layers
p 161 A92-10689
3-D loss prediction based on secondary flow and blade shear layer interaction
[ASME PAPER 91-GT-59] p 7 A92-15536
Quasi-three-dimensional characteristics method for a supersonic compressor rotor
[ASME PAPER 91-GT-81] p 7 A92-15549
Three dimensional flow in a linear compressor cascade at design conditions
[ASME PAPER 91-GT-114] p 8 A92-15565
The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology
[ASME PAPER 91-GT-124] p 8 A92-15569
Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis
[ASME PAPER 91-GT-203] p 93 A92-15625
Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models
[ONERA, TP NO. 1991-110] p 163 A92-16089
Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations
[ONERA, TP NO. 1991-131] p 9 A92-16107
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis
p 11 A92-21504
Model and computation of discrete jets in crossflow
p 165 A92-21505
Application of holomorphic vectors theory in three-dimensional potential flow problem
p 165 A92-21923
Validation of a 3D Navier-Stokes code on experimental compressor bladings
[ONERA, TP NO. 1991-229] p 13 A92-26381

- Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation
[ONERA, TP NO. 1991-235] p 168 A92-26386
Three-dimensional unsteady flow calculations in both intake port and combustion chamber
[AIAA PAPER 92-0833] p 169 A92-29599
Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers
p 171 A92-32228
The effects of wall suction on laminar-turbulent transition in three-dimensional flow
p 15 A92-36021
The computation of three-dimensional flows using unstructured grids
p 16 A92-37539
An information system for the numerical simulation of 3D Euler flows around aircraft
p 16 A92-37554
Three-dimensional separated flows
p 173 A92-40088
On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities
p 175 A92-41655
Secondary flow investigation inside the passage of a compressor cascade
p 19 A92-42124
Calculation of three-dimensional turbulent flow in wind tunnel entry section
p 19 A92-43055
An experimental investigation of the oblique blade-vortex interaction
p 19 A92-43447
Convection-induced shears for general planforms
p 177 A92-44352
The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations
[AIAA PAPER 92-2619] p 256 A92-45492
An unfactored implicit scheme for 3D inviscid transonic flows
[AIAA PAPER 92-2668] p 20 A92-45523
Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method
[ONERA, TP NO. 1992-1] p 23 A92-48577
Separation and vortex formation in turbulent flows
[ONERA, TP NO. 1992-7] p 24 A92-48579
Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique
p 26 A92-54308
Spin-up in a semicircular cylinder
p 184 A92-56123
Numerical simulation of vortex breakdown via 3-D Euler equations
p 185 N92-10164
Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code
[CERT-RT-63/5618-54] p 185 N92-11306
Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures
[DLR-FB-91-09] p 113 N92-12005
Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity
[PREPRINT-1365] p 187 N92-12219
The turbomachine blading design using S2-S1 approach
p 97 N92-13940
Efficient solution of three-dimensional viscous hypersonic flows
p 37 N92-15007
A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows
p 188 N92-15026
Grid impact on 3D hypersonic flows
p 39 N92-15041
A deficit approach to three dimensional incompressible flows
[CERT-RF-39/5025-36] p 192 N92-19294
Three-dimensional simulations of hypersonic flows
[MBB-UK-0155-89-PUB] p 42 N92-21703
Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve
p 100 N92-27462
Computation and visualization of specific flow phenomena in turbomachinery application
p 100 N92-27463
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
p 101 N92-27466
Validation of non-orthogonal three-dimensional laminar flow predictions
p 199 N92-27476
Three dimensional flow in sharp bends --- ducted flow
p 200 N92-27481
The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle
p 200 N92-27482
Nonequilibrium 3D flows of air through inlets
p 200 N92-27487
Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models
p 200 N92-27490
Development and validation of a characteristic boundary condition for a cell-centered Euler method
[NLR-TP-90144-U] p 47 N92-28692

- Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration
[ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference
[NLR-TR-88072-U] p 49 N92-29884
- Numerical simulation of turbulence at the back of the airplane
[ETN-92-91664] p 51 N92-32769
- Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements
[ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- The 3-D Euler flows around modern airplanes
[PB92-138759] p 52 N92-70540

THREE DIMENSIONAL MODELS

- Lightning strike simulation using coaxial line technique and 3D linear injection current analysis
p 159 A92-20131
- Unsteady three-dimensional Benard convection - Light-scattering, statistics and chaos
p 168 A92-27379
- Cell vertex finite volume discretizations in three dimensions
p 168 A92-27475
- A 3D finite element multigrid solver for the Euler equations
[AIAA PAPER 92-0449] p 171 A92-31665
- Two-point optimization of complete three-dimensional airplane configuration
[AIAA PAPER 92-2618] p 73 A92-45491
- An unstructured mesh generation algorithm for three-dimensional aeronautical configurations
p 262 A92-47053
- Fast finite element solvers for reentry flows
p 35 N92-14988
- Viscous shock-layer equations for the calculation of reentry aerothermodynamics
p 37 N92-15008
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection
p 38 N92-15025
- Practical application of 3-D CFD methods to gas turbine combustors
[PNR-90773] p 194 N92-21742
- Computational procedures for preliminary design
p 84 N92-23952
- Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-190353] p 43 N92-25959
- Steady and unsteady 3D flow computation through a transonic turbine stage
p 101 N92-27469
- Multidimensional upwind methods for unstructured grids
p 201 N92-27675
- THREE DIMENSIONAL MOTION**
- The avoidance of collisions for Newtonian bodies with hidden variables
p 59 A92-24945
- THRESHOLDS (PERCEPTION)**
- Risk to hearing from overflight noise of military aircraft
[ISVR-TR-194] p 270 N92-22241
- THRUST AUGMENTATION**
- The application of high pressure ejectors to reaction control systems
p 93 A92-16666
- THRUST CONTROL**
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft
[RAE-TM-FS-1009] p 107 N92-12004
- Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle
p 34 N92-14985
- Experimental investigation of transverse jet effects related to hypersonic space vehicles
p 36 N92-14995
- ASTOVL engine control
[PNR-90808] p 100 N92-27040
- THRUST VECTOR CONTROL**
- X-31 enhancement of aerodynamics for maneuvering beyond stall
p 80 N92-18779
- Fuzzy guidance system evaluation
p 259 N92-27903
- THRUST-WEIGHT RATIO**
- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft
p 71 A92-37074
- THRUSTORS**
- Near-field expansion in thruster plumes
p 141 A92-52799
- TILT ROTOR AIRCRAFT**
- Requirements and possible technical solutions derived from the new air mobility concept of the German Army
p 1 A92-14348
- The Eurofar vehicle overview
p 67 A92-14416
- Tilting at targets - tilt rotor aircraft development
p 68 A92-25074
- The Eurofar program - An European overview on advanced VTOL civil transportation system
p 4 A92-56299
- Short takeoff optimization for the XV-15 tiltrotor aircraft
p 74 A92-56302

- Development of a conceptual design method for rotary-wing aircraft using digital computers
p 75 A92-56340
- The Eurofar program: An European overview on advanced VTOL civil transportation system
[MBB-UD-0611-91-PUB] p 58 N92-30418
- TIME DEPENDENCE**
- Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations
p 166 A92-23289
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 N92-28365
- TIME DEPENDENT MULTIPLE ACCESS**
- Italsat spacecraft multibeam payload antenna closed loop line pointing system
[IAF PAPER 91-509] p 129 A92-18519
- TIME MARCHING**
- Efficient solution of three-dimensional viscous hypersonic flows
p 37 N92-15007
- Cell vertex methods for compressible gas flows
p 197 N92-26599
- Time-marching methods for secondary flow analysis in curved ducts
p 198 N92-27454
- The application of a Navier-Stokes CFD method to civil engine intake flows
p 199 N92-27471
- TIME OPTIMAL CONTROL**
- A dynamics parameter invariant attitude control system for flexible spacecraft
p 130 A92-15384
- TIME SERIES ANALYSIS**
- An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 N92-17169
- TIROS N SERIES SATELLITES**
- A comparison of satellite sounding data and aircraft measurements within a mature polar low
p 237 A92-32489
- TITAN**
- ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft
p 285 N92-25679
- Titan's atmosphere structure from Huygen's-ASI measurements
p 285 N92-32398
- TITANIUM ALLOYS**
- The beta-CEZ - A high performance titanium alloy for aerospace engines
p 148 A92-22760
- Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery
p 210 A92-22773
- Cost effective solutions for titanium sheet metal forming
p 211 A92-22785
- Investigation of the structural inhomogeneity of a titanium alloy
p 149 A92-47958
- High temperature processing and deformation of a near-alpha titanium alloy
[PNR-90853] p 149 N92-20911
- TITANIUM COMPOUNDS**
- Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP
p 219 N92-14420
- TOLERANCES (MECHANICS)**
- Fatigue and damage tolerance verification of aircraft structures
p 217 A92-19677
- Aircraft tracking optimization of parameters selection
p 79 N92-18585
- The Operational Loads Monitoring System, OLMS
p 79 N92-18586
- Fatigue management for the A-7P
p 79 N92-18593
- Introduction: Needs and approaches to reliability and quality assurance in design and manufacture
p 216 N92-19005
- Damage tolerance and durability evaluation of aluminum-lithium alloys
[PB91-219477] p 150 N92-70307
- Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989
[PB92-138650] p 88 N92-70591
- TOLLIEN-SCHLICHTING WAVES**
- Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers
p 171 A92-32228
- The nonlinear stability of flows over compliant walls
p 179 A92-46265
- TOPOGRAPHY**
- Computation of aircraft noise exposure using digitized topography data
p 227 A92-39058
- Mean wind speeds over hills and other topography
[ESDU-91043] p 240 N92-17853
- TOPOLOGY**
- Topology of steady flows of low viscosity fluids
p 162 A92-11219
- TOROIDS**
- Spray nozzle for fire control
[CA-PATENT-APPL-SN-2-011-94] p 205 N92-32856
- TORQUE**
- Spacecraft attitude control using magnetic torquers and gas jets
p 137 N92-24496

TORSIONAL STRESS

- Design and manufacturing of torsional flexible blade models
p 71 A92-35780
- TOTAL OZONE MAPPING SPECTROMETER**
- On the relation between total ozone and meteorology
p 236 A92-27796
- Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone
p 231 A92-54645
- TOTAL QUALITY MANAGEMENT**
- Implementation of the total quality management concept within space business
p 275 N92-18640
- TOUCHDOWN**
- Effective cueing during approach and touchdown: Comparison with flight
p 117 N92-28552
- TOUGHNESS**
- Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] p 76 N92-14042
- TOWED BODIES**
- Accurate current measurement using drogued buoys employing Decca Navigator and Argos
p 241 A92-12278
- Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system
p 71 A92-35937
- TRACE CONTAMINANTS**
- Fourth European Symposium on Space Environmental Control Systems, volume 1
[ESA-SP-324-VOL-1] p 138 N92-25828
- TRACKING (POSITION)**
- Aircraft tracking for structural fatigue
p 79 N92-18584
- Aircraft tracking optimization of parameters selection
p 79 N92-18585
- Development of new flight procedures for the Microwave Landing System (MLS)
[NLR-TP-91156-U] p 66 N92-32830
- TRACKING FILTERS**
- New practical method for measurement error determination in radar systems under real traffic conditions
p 155 A92-17238
- TRAILING EDGE FLAPS**
- Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil
p 16 A92-38858
- Trimming rotor blades with periodically deflecting trailing edge flaps
p 106 A92-56283
- Maximum lift of wings with trailing-edge flaps at low speeds
[ESDU-91014] p 28 N92-11970
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations
p 45 N92-27945
- Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds
[ESDU-92002-SUPPL] p 51 N92-32782
- TRAILING EDGES**
- Secondary flow investigation inside the passage of a compressor cascade
p 19 A92-42124
- Application of direct inverse analogy method (DIVA) and viscous design optimization techniques
p 33 N92-13951
- LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] p 33 N92-14004
- Case 7.4 delta wing: Navier-Stokes calculation
p 42 N92-22182
- Spacecraft thermal control coatings
p 151 N92-24829
- Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft
p 108 N92-27958
- Yacht sail aerodynamics. Part 2: Achievable mainsail specification
[ISBN-0-904947-16-5] p 52 N92-70514
- TRAINING AIRCRAFT**
- Tomorrow's Goshawk flies
p 68 A92-18001
- British Aerospace Hawk into the 1990s
p 73 A92-50009
- Investigation of the tail buffeting of the C-101
p 26 A92-53253
- Parametric effects of some aircraft components on high-alpha aerodynamic characteristics
p 80 N92-18782
- TRAINING DEVICES**
- AM-X flight simulator from engineering tool to training device
p 116 N92-28536
- TRAINING SIMULATORS**
- Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates
[DLR-FB-91-23] p 64 N92-20902
- Validation of simulation systems for aircraft acceptance testing
p 86 N92-28531
- Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532

- AM-X flight simulator from engineering tool to training device p 116 N92-28536
- The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 N92-28539
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616
- TRAJECTORIES**
- On board planning of 4D-trajectories p 66 N92-27897
- Optimal guidance anticipating missile performance p 128 N92-27902
- TRAJECTORY ANALYSIS**
- Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764
- Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 N92-20477
- Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 N92-20573
- TRAJECTORY CONTROL**
- Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
- Reentry control of a low-lift maneuverable spacecraft [AIAA PAPER 92-4455] p 124 A92-55216
- Optimal guidance anticipating missile performance p 128 N92-27902
- TRAJECTORY MEASUREMENT**
- Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601
- TRAJECTORY OPTIMIZATION**
- Terminal area traffic management p 61 A92-50122
- Optimal finite-thrust spacecraft trajectories [AIAA PAPER 92-4510] p 124 A92-52080
- Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645
- Solving the aeroassisted orbital transfer problem by using a sequential optimization approach [AIAA PAPER 92-4646] p 124 A92-55401
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers [ESDU-91016-ADD] p 77 N92-15987
- Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 N92-32229
- TRAJECTORY PLANNING**
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- TRANSFER OF TRAINING**
- Knowledge transfer and support systems in fighter aircraft p 251 A92-45047
- G-tolerance and spatial disorientation: Can simulation help us? p 248 N92-28534
- AM-X flight simulator from engineering tool to training device p 116 N92-28536
- TRANSFER ORBITS**
- Atmospheric re-entry p 123 A92-33409
- Optimal finite-thrust spacecraft trajectories [AIAA PAPER 92-4510] p 124 A92-52080
- Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 N92-24504
- Limitation of space debris in geostationary transfer orbit p 125 N92-24774
- TRANSFORMATIONS (MATHEMATICS)**
- Wavelet transforms and their applications to turbulence p 177 A92-45091
- TRANSITION FLOW**
- Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
- Transition to turbulence in curved channel flow p 18 A92-40125
- Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet p 183 A92-52794
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
- Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032
- Transitional flows around re-entry bodies p 38 N92-15035
- Hypersonic wakes [ETN-92-91082] p 41 N92-19925
- Boundary layers and transition on concave surfaces p 196 N92-24341
- Numerical prediction of boundary layers and transitional flows p 196 N92-24342
- TRANSMISSIONS (MACHINE ELEMENTS)**
- Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
- TRANSMISSOMETERS**
- Trial of a slant visual range measuring device p 210 N92-31043
- TRANSONIC COMPRESSORS**
- On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
- TRANSONIC FLIGHT**
- Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors [ONERA, TP NO. 1991-178] p 10 A92-16140
- Aerodynamic computations of high-speed transonic propellers [ONERA, TP NO. 1991-218] p 13 A92-26370
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
- Inviscid drag prediction for transonic transport wings using a full-potential method [NLR-TP-89365-U] p 41 N92-20473
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 N92-32732
- NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750
- TRANSONIC FLOW**
- Solution of the Reynolds-averaged Navier-Stokes equations for transonic aerofoil flows p 6 A92-13198
- Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675
- Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
- Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
- Transonic cascade flow prediction using the Navier-Stokes equations [ASME PAPER 91-GT-313] p 8 A92-15690
- Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines [ONERA, TP NO. 1991-170] p 110 A92-16135
- Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
- Concerning the functional solution of transonic flows p 11 A92-21318
- An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
- A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
- Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
- A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
- Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations [AIAA PAPER 92-2613] p 20 A92-45487
- Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions [AIAA PAPER 92-2638] p 20 A92-45507
- An unfactored implicit scheme for 3D inviscid transonic flows [AIAA PAPER 92-2668] p 20 A92-45523
- Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546
- Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections [AIAA PAPER 92-2653] p 21 A92-45569
- The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
- Effect of model cooling on periodic transonic flow p 22 A92-46900
- Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038
- Mesh adaptivity with the quadtree method p 22 A92-47041
- 3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
- Unstructured multigriding by volume agglomeration - Current status p 179 A92-47157
- Calculation of noise generated in flows on the basis of an aerodynamic/acoustic decomposition [ONERA, TP NO. 1992-35] p 267 A92-48596
- Numerical computations of transonic flows through cascades [AIAA PAPER 92-3041] p 24 A92-48702
- A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
- A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- Hot-wire measurements in turbulent transonic flows p 26 A92-53078
- Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302
- Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
- Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 N92-10989
- Control aspects of the transition from transversal to transonic flow, step effects [ETN-91-90106] p 29 N92-11981
- Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215
- Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
- Blade design and analysis using a modified Euler solver p 97 N92-13952
- Research on inverse methods and optimization in Italy p 97 N92-13956
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 N92-14319
- A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows [ESDU-91021] p 39 N92-15970
- Drag prediction using computation methods [ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682
- Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 N92-19932
- Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds [NLR-TP-90029-U] p 41 N92-20498
- Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466
- Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
- Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
- Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
- Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657
- Wave drag determination in the transonic full-potential flow code MATRICES [NLR-TP-90062-U] p 47 N92-28709
- Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118

- Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 N92-30514
- Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations [ONERA-RSF-24/1408-AY-150A] p 51 N92-32773
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 N92-70561
- System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
- TRANSONIC FLUTTER**
- The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
- TRANSONIC SPEED**
- Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711
- Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958
- TRANSONIC WIND TUNNELS**
- Automation of the measurement process in the N2 wind tunnel with the SPITA N-3 system p 110 A92-12347
- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323
- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336
- An overview of the planned aerospace test facilities at Capua, Italy [AIAA PAPER 92-3944] p 112 A92-56773
- The windtunnel as a tool for laminar flow research [NLR-TP-90145-U] p 117 N92-28661
- TRANSPARATION**
- The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986
- TRANSPORT AIRCRAFT**
- The Eurofar vehicle overview p 67 A92-14416
- Detailed analysis of wing-nacelle interaction for commercial transport aircraft [ONERA, TP NO. 1991-152] p 9 A92-16122
- Air transport research in Germany p 1 A92-17095
- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- Supersonic transport in the 21st century p 2 A92-26793
- Mass-transporter p 69 A92-34650
- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- Engine reliability p 95 A92-39309
- Panel method control in 3-D hyperbolic grid generation p 17 A92-39940
- The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations [AIAA PAPER 92-2619] p 256 A92-45492
- Trends in commercial aircraft design - What evolution factors and what approach? p 4 A92-48587
- A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
- The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary [ONERA-RTS-21/4365-AY-056A] p 76 N92-11009
- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- The G-222 aircraft individual tracking programme p 78 N92-18582
- The Operational Loads Monitoring System, OLMS p 79 N92-18586
- Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 N92-23238
- Drag reduction: An industrial challenge p 44 N92-27708
- Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547

- Hyperbolic grid generation with BEM source terms [NLR-TP-90334-U] p 264 N92-28635
- Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
- Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 N92-29604
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616
- TRANSPORT PROPERTIES**
- Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451
- Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739
- Transport coefficients in discrete kinetic theory and comparison with classical fluid dynamics p 274 A92-52782
- Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317
- TRANSPORT THEORY**
- Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
- Computation of impinging flows using second-moment closures p 173 A92-40083
- Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
- Models of turbulence in a hypersonic boundary layer p 19 A92-41817
- A spectral model for turbulent transport p 178 A92-45095
- Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model --- of trace elements in middle atmosphere p 239 A92-53349
- TRANSPUTERS**
- A fire field model implemented in a parallel computing environment p 166 A92-23252
- Parallel processing applications for gas turbine engine control p 96 N92-11012
- TRAVELING WAVES**
- Noise-driven flows p 10 A92-18680
- TREES (MATHEMATICS)**
- A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
- Mesh adaptivity with the quadtree method p 22 A92-47041
- TRENDS**
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
- TRIANGULATION**
- Cell vertex finite volume discretizations in three dimensions p 168 A92-27475
- A frontal approach for node generation in Delaunay triangulations p 201 N92-27680
- TRITIUM**
- Modelling compressible turbulent mixing p 178 A92-45094
- TROPICAL STORMS**
- A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
- The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
- TROPOPAUSE**
- Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336
- The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048
- TROPOSPHERE**
- Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193
- Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
- Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances p 232 A92-55441
- Reduction of target scattering by tropospheric modification p 157 N92-19164
- Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
- The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048

TRUSSES

- Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 N92-28650

TUNABLE LASERS

- CO2 laser active remote sensing from 2 to 11 microns: Airborne and laboratory application p 223 N92-11535

TUNING

- Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815

TURBINE BLADES

- Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533
- Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
- Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
- The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
- Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
- Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 N92-12203
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- Blade design and analysis using a modified Euler solver p 97 N92-13952
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
- An integrated CFD system for 3D turbomachinery applications p 101 N92-27464

TURBINE ENGINES

- Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
- Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary [ONERA-RTS-21/4365-AY-056A] p 76 N92-11009
- Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244
- Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 N92-20179

TURBINE INSTRUMENTS

- An Axial Turbopump [ASME PAPER 91-GT-1] p 211 A92-15501

TURBINE WHEELS

- Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles [ONERA, TP NO. 1992-31] p 218 A92-48592
- Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
- Radial inflow turbine study [AD-A246938] p 101 N92-28073

TURBINES

- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

TURBOCOMPRESSORS

- Design and performance of advanced blading for a high-speed HP compressor [ASME PAPER 91-GT-374] p 9 A92-15718
- The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
- Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701

- Radial inflow turbine study
[AD-A240169] p 96 N92-11015
- The role of crack growth in defect assessment
[PNR-90798] p 220 N92-20909
- Boundary layer flow in axial compressors (theoretical part)
[ETN-92-91006] p 194 N92-21232
- Boundary layer flow in axial compressors (theoretical part)
[ETN-92-91008] p 194 N92-21234
- Compressing the compressor
[PNR-90824] p 99 N92-21848
- Application of S1BYL2 to the AGARD WG18 compressor test cases
p 198 N92-27452
- Radial inflow turbine study
[AD-A252783] p 214 N92-33538
- TURBOFAN AIRCRAFT**
- Selection of a laser anemometer technique for propeller tests in wind tunnels
[PB92-138510] p 118 N92-70563
- TURBOFAN ENGINES**
- Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel
[ONERA, TP NO. 1991-219] p 111 A92-26371
- Rafale M - Dassault's Squall at sea
p 71 A92-37874
- NASA's quiet side. I
p 3 A92-37875
- CIS engines - The range revealed. II
p 96 A92-54546
- Experimental study of noise generation and propagation in a turbofan model
[ONERA, TP NO. 1992-199] p 268 A92-56169
- Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel
[AIAA PAPER 92-4003] p 209 A92-56826
- TURBOFANS**
- Advanced tactical fighter engine
[ETN-92-90840] p 97 N92-18728
- Re-engineing appears to offer best payback for young: Chapter 2 compliant aircraft
[PNR-90848] p 98 N92-19939
- Steady and transient performance calculation method for prediction, analysis, and identification
p 102 N92-28461
- TURBOJET ENGINE CONTROL**
- A multivariable control concept for a gas turbine engine
[ETN-92-92104] p 102 N92-33645
- TURBOJET ENGINES**
- Combat aircraft jet engine noise studies
[ONERA, TP NO. 1991-192] p 266 A92-26353
- The turbo-ramjet Griffon
p 286 A92-41820
- Advanced tactical fighter engine
[ETN-92-90840] p 97 N92-18728
- TURBOMACHINE BLADES**
- Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction
p 14 A92-30000
- Arbitrary blade section design based on viscous considerations - Background information
p 15 A92-36029
- The turbomachine blading design using S2-S1 approach
p 97 N92-13940
- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation
p 45 N92-27944
- Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades
[ETN-92-92056] p 205 N92-33910
- TURBOMACHINERY**
- The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology
[ASME PAPER 91-GT-124] p 8 A92-15569
- Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines
[ONERA, TP NO. 1991-170] p 110 A92-16135
- A PC-based inverse design method for radial and mixed flow turbomachinery
p 97 N92-13943
- Research on inverse methods and optimization in Italy
p 97 N92-13956
- The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation
[PNR-90791] p 194 N92-22099
- Boundary Layers in Turbomachines
[VKI-LS-1991-06] p 99 N92-24336
- CFD Techniques for Propulsion Applications
[AGARD-CP-510] p 198 N92-27450
- On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades
p 198 N92-27460
- Computation and visualization of specific flow phenomena in turbomachinery application
p 100 N92-27463
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities
p 199 N92-27475
- TURBOPROP AIRCRAFT**
- Active vibrations and noise control for turboprop application research program activities
p 271 N92-32962
- TURBULENCE**
- Boundary layer transition on concave surfaces
p 195 N92-22200
- Separation of relaminarised boundary layers
[CUED/A-AERO/TR-16] p 195 N92-22209
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum
p 196 N92-24343
- Turbulence modelling in CFD: Present status, future prospects
p 197 N92-24515
- Aircraft observation of a small-scale solitary wave near the tropopause
p 234 N92-26336
- Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle
[ETN-92-91959] p 204 N92-32725
- Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level
[ETN-92-92088] p 204 N92-32765
- Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames
[ETN-92-92103] p 205 N92-33916
- TURBULENCE EFFECTS**
- Hang-glider response to atmospheric inputs
p 104 A92-46765
- Some important factors in turbulence in flight measurement
p 90 A92-54324
- Review of aircraft dynamic loads due to flow separation
p 31 N92-13008
- Turbulent skin-friction drag reduction by active and passive means, part 1
p 44 N92-27714
- TURBULENCE METERS**
- A hot wire method for measuring turbulence in transonic or supersonic heated flows
p 207 A92-50037
- Study of a technique of low level turbulence detection
[ETN-91-90107] p 186 N92-12215
- TURBULENCE MODELS**
- Solution of the Reynolds-averaged Navier-Stokes equations for transonic aerofoil flows
p 6 A92-13198
- Turbine cascade calculations through a fractional step Navier-Stokes algorithm
[ASME PAPER 91-GT-55] p 7 A92-15533
- Turbulence modelling for secondary flow prediction in a turbine cascade
[ASME PAPER 91-GT-57] p 7 A92-15535
- Empirical determination of universal multifractal exponents in turbulent velocity fields
p 165 A92-21461
- Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil
[AIAA PAPER 92-0027] p 11 A92-22149
- Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids
p 14 A92-28523
- Velocity correlation in isotropic turbulence according to a modified Obukhov theory
p 169 A92-28950
- Second moment closure predictions of jet-on-jet impingement flows
p 173 A92-40102
- An algebraic property of the turbulent stress and its possible use in subgrid modeling
p 174 A92-40129
- Progress and paradoxes in modelling near-wall turbulence
p 174 A92-40158
- Numerical simulation and modelling of the transition past a rectangular afterbody
p 175 A92-40170
- Models of turbulence in a hypersonic boundary layer
p 19 A92-41817
- Modelling compressible turbulent mixing
p 178 A92-45094
- A spectral model for turbulent transport
p 178 A92-45095
- Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver
p 23 A92-48207
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] p 187 N92-14319
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] p 188 N92-14328
- Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations
p 213 N92-14360
- Hypersonic boundary layers: Transition and turbulence effects
p 188 N92-14976
- Towards the computation of turbulent hypersonic flows
[AERO-REPT-9106] p 40 N92-18318
- Marco contract report
[ETN-92-91077] p 193 N92-20232
- Turbulence modelling in CFD: Present status, future prospects
p 197 N92-24515
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade
p 198 N92-27457
- An integrated CFD system for 3D turbomachinery applications
p 101 N92-27464
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
p 101 N92-27466
- Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects
[NLR-TP-90184-U] p 201 N92-28694
- A dynamic subgrid-scale eddy viscosity model
p 203 N92-30649
- A subgrid-scale model based on the second-order velocity structure function
p 203 N92-30651
- TURBULENT BOUNDARY LAYER**
- An approximate method for treating a turbulent boundary layer with symmetry of revolution
p 164 A92-21306
- Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method
[ONERA, TP NO. 1991-212] p 13 A92-26364
- A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55
p 14 A92-28006
- Cylinder-induced shock-wave boundary-layer interaction
p 15 A92-31188
- Bursts and sources of pressure fluctuation in turbulent boundary layers
p 17 A92-40055
- Influence of suction through a slot on a turbulent boundary layer
p 18 A92-40127
- Experimental and numerical investigation of a turbulent boundary layer over riblets
p 18 A92-40128
- Computations of a separated turbulent boundary layer
p 174 A92-40131
- A model for bursting of near wall vortical structures in boundary layers
p 174 A92-40156
- Analysis of wind tunnel dispersion data over two-dimensional obstacles
p 228 A92-42093
- Total losses in turbulent flows inside conical diffusers
p 23 A92-47782
- Computation of the flow and heat transfer due to a rotating disc
p 180 A92-48203
- An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers
p 180 A92-48206
- The structure of a turbulent free shear layer in a rotating fluid
p 183 A92-54487
- Turbulence control by intake
[CERT-RF-67/5004-37] p 186 N92-12211
- Study of a technique of low level turbulence detection
[ETN-91-90107] p 186 N92-12215
- Hypersonic boundary layers: Transition and turbulence effects
p 188 N92-14976
- Towards the computation of turbulent hypersonic flows
[AERO-REPT-9106] p 40 N92-18318
- Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow
[ONERA-NT-1991-9] p 193 N92-19932
- Boundary layers and transition on concave surfaces
p 196 N92-24341
- Interaction between shock wave and tubular flow
p 197 N92-24392
- Basic concepts on boundary layers
p 44 N92-27707
- Turbulent skin-friction drag reduction by active and passive means, part 1
p 44 N92-27714
- Computation of viscous phenomena in unsteady transonic flow
p 46 N92-27949
- Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects
[NLR-TP-90184-U] p 201 N92-28694
- Turbulent spot generation and growth rates in a transonic boundary layer
[AD-A250221] p 202 N92-29118
- A dynamic subgrid-scale eddy viscosity model
p 203 N92-30649
- Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level
[ETN-92-92088] p 204 N92-32765
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils
[PB92-138569] p 206 N92-70561
- TURBULENT DIFFUSION**
- Numerical simulation of unsteady rotor wakes
p 27 A92-56352
- A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence
[MEMO-1009] p 202 N92-29972

TURBULENT FLOW

Solution of the Reynolds-averaged Navier-Stokes equations for transonic aeroflow flows p 6 A92-13198
Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483
Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
Numerical computation of internal and external flows. Vol. 2 - Computational methods for inviscid and viscous flows --- Book p 166 A92-22624
[ISBN 0-471-92351-6]
Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967
The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054
Turbulent energy budgets in impinging zones p 17 A92-40081
Computation of impinging flows using second-moment closures p 173 A92-40083
Three-dimensional separated flows p 173 A92-40088
Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
Transition to turbulence in curved channel flow p 18 A92-40125
Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172
Turbulence - The filtering approach p 175 A92-41656
Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
Helicity in laminar and turbulent flow p 177 A92-45089
Wavelet transforms and their applications to turbulence p 177 A92-45091
Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method [ONERA, TP NO. 1992-1] p 23 A92-48577
Separation and vortex formation in turbulent flows [ONERA, TP NO. 1992-7] p 24 A92-48579
Experimental and theoretical investigation of a homogeneous turbulent shear flow p 180 A92-48604
[ONERA, TP NO. 1992-43]
Modelling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
Organized structures in the developing region of axisymmetric jet flow p 182 A92-51892
Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724
Hot-wire measurements in turbulent transonic flows p 26 A92-53078
Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique p 26 A92-54308

Spectral analysis with a LDA in high speed flow p 209 A92-54339
Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
Boundary layer transition [CERT-RTS-55/5018-45] p 186 A92-12210
Turbulence control by intake [CERT-RF-67/5004-37] p 186 A92-12211
Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55] p 187 A92-12216
On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 A92-13003
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 A92-14004
Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 A92-14992
Towards the computation of turbulent hypersonic flows [AERO-REPT-9106] p 40 A92-18318
The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 p 192 A92-18933
[AD-A243809]
The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 A92-18934
A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 A92-19294
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-90867] p 192 A92-19349
Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 A92-20317
On the determination of turbulent mixing coefficients from Eulerian current data p 195 A92-22121
The COPPEF-model for solid fuel combustion chamber performance prediction p 142 A92-22270
Boundary Layers in Turbomachines [VKI-LS-1991-06] p 99 A92-24336
Interaction between shock wave and tubular flow p 197 A92-24392
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 A92-27457
Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 A92-27462
Computational modelling of turbulent flow in S-bends p 199 A92-27480
Flow computation in combustion chambers using zonal nonstaggered grids p 200 A92-27483
Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 A92-27484
The coherent flamelet model for propulsion applications p 147 A92-27486
Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 A92-27714
A dynamic subgrid-scale eddy viscosity model p 203 A92-30649
A subgrid-scale model based on the second-order velocity structure function p 203 A92-30651
Continuous wavelet analysis of coherent structures p 203 A92-30673
Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 A92-31942
Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 A92-32769
Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 A92-33996
TURBULENT HEAT TRANSFER
Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 A92-12203
Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 A92-29118
TURBULENT JETS
Model and computation of discrete jets in crossflow p 165 A92-21505
Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study p 178 A92-45603
TURBULENT MIXING
Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
Modelling compressible turbulent mixing p 178 A92-45094
A spectral model for turbulent transport p 178 A92-45095

Marco contract report [ETN-92-91077] p 193 A92-20232
On the determination of turbulent mixing coefficients from Eulerian current data p 195 A92-22121
TURBULENT WAKES
Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347
Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
Compressibility effects in turbulent far wakes p 18 A92-40140
Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow [REPT-90/59] p 29 A92-11982
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 A92-12157
Investigation on the control of a Karman vortex street [MPIS-99/1990] p 40 A92-17315
TVD SCHEMES
High resolution schemes for steady flow computation p 161 A92-10036
A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006
Multidimensional upwind methods for unstructured grids p 201 A92-27675
Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 A92-27678
TWO DIMENSIONAL BODIES
Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546
Construction of a numerical optimization method for the definition of hypersupported profiles [ONERA-RSF-43/1736-AY-146A] p 202 A92-28788
TWO DIMENSIONAL BOUNDARY LAYER
Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
TWO DIMENSIONAL FLOW
Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
Supersonic stator-rotor interaction in a turbine stage [ONERA, TP NO. 1991-166] p 10 A92-16133
Concerning the functional solution of transonic flows p 11 A92-21318
On the Arnol'd stability criterion for steady-state flows of an ideal fluid p 165 A92-21506
An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451
Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
Secondary flow investigation inside the passage of a compressor cascade p 19 A92-42124
A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068
Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
Mesh adaptivity with the quadtree method p 22 A92-47041
Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
Application of a variational method in compressible flow computations p 179 A92-47070
Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile [CERT-RT-65/5604-35] p 185 A92-11307
Resolution of Navier-Stokes equations around profiles: Drag evolution [ONERA-RTS-86/1685-AY-156A] p 186 A92-11310

Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
 Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023
 The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 N92-18291
 Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784
 Improved shock-capturing of Jameson's scheme for the Euler equations p 196 N92-23251
 Numerical prediction of boundary layers and transitional flows p 196 N92-24342
 The 2D-computation of an axial fan with FINFLO [PB92-180678] p 203 N92-30023
 Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767
TWO DIMENSIONAL JETS
 Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 N92-32769
TWO DIMENSIONAL MODELS
 Vectorising the smooth particle hydrodynamics p 161 A92-10037
 A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994
 Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
 A theoretical test of the geostrophic momentum approximation p 237 A92-39471
 Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
 The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model --- of trace elements in middle atmosphere p 239 A92-53349
 Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow [REPT-90/59] p 29 N92-11982
 LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 N92-14004
 The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
 Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989
 Multidimensional upwind methods for unstructured grids p 201 N92-27675
 Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations [ONERA-RSF-24/1408-AY-150A] p 51 N92-32773
TWO PHASE FLOW
 Behavior of a suspension in the presence of a potential vortex [ONERA, TP NO. 1991-140] p 163 A92-16114
 Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
 An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
 Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
 Propagation of shock waves through clouds [AERO-REPT-9104] p 191 N92-18317
 The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18 [AD-A243809] p 192 N92-18933
 Two-phase thermal technology for space application: Development status p 138 N92-25834
TWO STAGE PLASMA ENGINES
 Aerothermodynamic challenges of the Saenger space-transportation system p 39 N92-15042

U

U.S.S.R.
 The bullish bear --- airline operations decentralization in the Commonwealth of Independent States p 2 A92-36350
 German-GUS cooperation in civil aviation p 3 A92-47592
 CIS engines. I - The range revealed p 4 A92-47821
 Russian realities --- changes in aviation industry infrastructure p 4 A92-53250
U.S.S.R. SPACE PROGRAM
 Soviet space at the crossroads p 118 A92-11881
 Twilight of the machine builders p 279 A92-20515
UK SPACE PROGRAM
 Skylark sounding rockets - Past and present p 286 A92-30108

The UK Parliamentary Space Committee - The emergence of a space lobby? p 281 A92-38793
ULTRAHIGH FREQUENCIES
 Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
ULTRAHIGH VACUUM
 Applications of ultra-high vacuum technique to surface and near-surface studies [ETN-92-90454] p 147 N92-14141
ULTRASONIC RADIATION
 Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773
ULTRASONIC TESTS
 Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088
 Training guidelines in non-destructive testing techniques [DE92-615083] p 217 N92-23258
 Ultrasonic investigation of (3)He-A vortices in low magnetic fields [PB92-142256] p 265 N92-23665
ULYSSES MISSION
 The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 N92-27049
UNCONSCIOUSNESS
 High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
 Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
 G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
 Circulatory biomechanics effects of accelerations p 248 N92-18991
 Study of the loss of consciousness inflight by fighter aircraft pilots [ONERA-RTS-11/3446-EY] p 249 N92-28844
UNCONTROLLED REENTRY (SPACECRAFT)
 The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967
 Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973
 Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 N92-23974
UNDERWATER ACOUSTICS
 Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386
UNIFORM FLOW
 Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347
 Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963
 Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution [ESDU-91029] p 39 N92-15973
 Numerical solutions for uniform flow around symmetrical bodies using panel methods [AERO-REPT-9014] p 192 N92-18320
UNIQUENESS
 Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372
UNITED KINGDOM
 A review of UK aviation policy [TT-9107] p 5 N92-12988
 Aircraft fatigue management in the Royal Air Force p 79 N92-18591
 Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969
UNITED STATES
 Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827
UNIVERSITY PROGRAM
 The use of large teams in conceptual aircraft design [AIAA PAPER 92-1092] p 274 A92-33257
 International Space University: Experiences and observations during Summer 1989 p 275 N92-25786
UNIX (OPERATING SYSTEM)
 A SAR processor for a GIS environment p 155 A92-34980
UNMANNED SPACECRAFT
 Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560
 Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
UNSTEADY AERODYNAMICS
 Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 161 A92-10654
 Lifting line predictions for a swept tip rotor blade p 7 A92-14424
 Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
 Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
 Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625
 Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations [ONERA, TP NO. 1991-187] p 10 A92-16141
 Computational methods in viscous aerodynamics --- Book p 11 A92-21976
 The position of the unsteady flow computation in the compressor and turbine design and analysis process [AIAA PAPER 92-0015] p 94 A92-22137
 Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction p 12 A92-24426
 Using Rankine vortices to model flow around a body of revolution p 169 A92-28061
 Hang-glider response to atmospheric inputs p 104 A92-46765
 A review of scale effects in unsteady aerodynamics p 24 A92-50121
 Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
 Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332
 Numerical simulation of unsteady rotor wakes p 27 A92-56352
 Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 N92-10989
 Nonstationary flight aerodynamics in a turbulent environment [ETN-91-90102] p 29 N92-11980
 Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
 FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
 A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
 Manoeuvring Aerodynamics [AGARD-CP-497] p 80 N92-18778
 Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
 Aeroelastic stability of aircraft at high incidence p 108 N92-18795
 Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
 Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940
 Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
 Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
 NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
 Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
 Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
 Computation of flutter boundaries in the time and frequency domain p 46 N92-27952
 A review of scale effects on surfaces in unsteady motion p 46 N92-27962
 NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91/134-U] p 109 N92-32750
 Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 N92-32776

- Introduction to Flutter of Winged Aircraft, volume 2
[VKI-LS-1992-01-VOL-2] p 109 N92-34161
- Unsteady wind tunnel tests p 109 N92-34166
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program
[PB92-138676] p 53 N92-70590

UNSTEADY FLOW

- Steady and unsteady 3D interactive boundary layers
p 161 A92-10689
- Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results
[ASME PAPER 91-GT-126] p 8 A92-15571
- An experiment on unsteady flow over an oscillating airfoil
[ASME PAPER 91-GT-181] p 8 A92-15613
- Noise-driven flow p 10 A92-18680
- An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
- Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation
[ONERA, TP NO. 1991-235] p 168 A92-26386
- A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows
p 14 A92-28005
- Three-dimensional unsteady flow calculations in both intake port and combustion chamber
[AIAA PAPER 92-0833] p 169 A92-29599
- Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
- Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
- Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
- Computer simulation of an unsteady flow around an airfoil with a spoiler p 19 A92-43167
- Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies
[AIAA PAPER 92-2704] p 21 A92-45546
- Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method
[ONERA, TP NO. 1992-1] p 23 A92-48577
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124
- Simulation of helicopter see-saw rotor motion p 74 A92-56287
- Jet noise classical theory and experiments p 268 N92-10602
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- The dynamic response of separated hypersonic flows p 38 N92-15019
- Development of an electronic high speed camera system for the quantitative analysis of unsteady flows
[MPIS-100/1991] p 209 N92-17344
- A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications)
[AERO-REPT-9002] p 190 N92-18088
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations p 191 N92-18221
- The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18
[AD-A243809] p 192 N92-18933
- Survey of experimental techniques for performance prediction p 84 N92-23954
- On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
- Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469
- Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- Unstructured grid methods for compressible flows p 201 N92-27676
- Transonic Unsteady Aerodynamics and Aeroelasticity
[AGARD-CP-507] p 44 N92-27936
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942

- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
- Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
- Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration
[ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements p 49 N92-29889
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils
[PB92-138569] p 206 N92-70561
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program
[PB92-138676] p 53 N92-70590

UPPER ATMOSPHERE

- The upper atmosphere as sensed by satellite orbits p 230 A92-30638
- Space activities in Italy p 121 A92-53457
- The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
- Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284

UPWELLING WATER

- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 N92-28365

UPWIND SCHEMES (MATHEMATICS)

- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations
[AIAA PAPER 92-2613] p 20 A92-45487
- Unstructured multigriding by volume agglomeration - Current status p 179 A92-47157
- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515

URBAN PLANNING

- Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 A92-39064

USER MANUALS (COMPUTER PROGRAMS)

- FLOVIS (FLOw VISualizer) user manual, release 2.6, September 1990 p 190 N92-16238
- Modernized MBB panel code: User's guide including background theory
[PB92-136431] p 43 N92-22233

USER REQUIREMENTS

- Requirements --- software development methods taking into account time and cost constraints p 255 A92-19382
- Swedish user support for Columbus p 120 A92-32469
- AGILE: An expert system for large space project management p 276 N92-20621
- National user interfaces p 224 N92-23407

V**V-2 MISSILE**

- France and the Peenemuende legacy
[IAF PAPER 92-0186] p 286 A92-55641

V/STOL AIRCRAFT

- The application of high pressure ejectors to reaction control systems p 93 A92-16666
- Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094
- RAE Bedford VAAC research project --- VSTOL aircraft advanced flight control p 104 A92-40039
- International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings
[ISBN 0-903409-68-2] p 3 A92-45302
- Evolution of ASTOVL aircraft design p 72 A92-45311
- Recent developments at the Shoeburyness STOVL test facility p 111 A92-45314
- Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315
- The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
- Some implications for advanced STOVL operation from invincible class ships p 82 N92-21971

- Recent developments at the Shoeburyness (England) STOVL Test Facility
[PNR-90806] p 115 N92-22096
- VSTOL engine design evolution: Growth of the Pegasus engine for Harrier
[PNR-90805] p 99 N92-27039
- ASTOVL engine control
[PNR-90808] p 100 N92-27040
- ASTOVL propulsion systems: Configuration and control choice
[PNR-90809] p 100 N92-27041
- VALIDITY**
- The requirements and management of quality audits and reviews
[PNR-90840] p 275 N92-20458
- VALVES**
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000

VANES

- Advanced superalloys for turbine blade and vane applications
[ONERA, TP NO. 1992-2] p 149 A92-48578
- Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes
[ONERA-RT-44/1621-RY-016-R] p 204 N92-32776

VAPOR DEPOSITION

- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292

VAPORIZERS

- Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

VARIABLE CYCLE ENGINES

- The selective bleed variable cycle engine --- aircraft propulsion
[ASME PAPER 91-GT-388] p 93 A92-15720

VARIABLE STREAM CONTROL ENGINES

- A multivariable control concept for a gas turbine engine
[ETN-92-92104] p 102 N92-33645

VARIATIONAL PRINCIPLES

- Application of a variational method in compressible flow computations p 179 A92-47070
- Four-dimensional data assimilation - Comparison of variational and sequential algorithms p 239 A92-51783
- Monopolar vortices as relative equilibria and their dissipative decay
[MEMO-1015] p 202 N92-29977

VECTOR PROCESSING (COMPUTERS)

- Parallel and vector aspects of a multigrid Navier-Stokes solver
[PB91-232868] p 260 N92-16645

VECTORS (MATHEMATICS)

- Vectorising the smooth particle hydrodynamics p 161 A92-10037
- Application of holomorphic vectors theory in three-dimensional potential flow problem p 165 A92-21923
- Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface p 263 A92-54574

VEGETATION

- Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

VEGETATIVE INDEX

- Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104

VELOCITY DISTRIBUTION

- An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
- Concerning the functional solution of transonic flows p 11 A92-21318
- Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461
- Velocity correlation in isotropic turbulence according to a modified Bukhov theory p 169 A92-28950
- Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
- Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511
- Turbulence control by intake
[CERT-RF-67/5004-37] p 186 N92-12211
- LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] p 33 N92-14004
- The flow past bluff bodies by a vortex method
[AERO-REPT-9016] p 191 N92-18291

On the approximate representation of velocity and shear stress distributions in low-speed boundary layers
[AERO-REPT-9012] p 192 N92-18319

Numerical solutions for uniform flow around symmetrical bodies using panel methods
[AERO-REPT-9014] p 192 N92-18320

Separation of relaminarised boundary layers
[CUED/A-AERO/TR-16] p 195 N92-22209

Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336

Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470

Three dimensional flow in sharp bends --- ducted flow p 200 N92-27481

Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions
[PB92-138577] p 118 N92-70574

VELOCITY MEASUREMENT

Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671

Aerosol behavior in supersonic flows
[ONERA, TP NO. 1991-155] p 206 A92-16124

The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade
[ASME PAPER 91-GT-221] p 179 A92-46825

Spectral analysis with a LDA in high speed flow p 209 A92-54339

Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile
[ONERA-RSF-44/1147-AY-144A] p 185 N92-11308

Characteristics of a boundary layer in a leading edge vortex p 31 N92-13012

LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] p 33 N92-14004

Stochastic perturbed systems: Theory and practice of Karman vortex streets
[MPIS-4/1991] p 193 N92-20180

Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317

Set-up and alignment aspects of a CO₂-laser radar for applications in the field p 158 N92-25378

Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059

Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region
[ETN-92-91489] p 205 N92-33996

VENTILATION

Indirect measurements of convective flow by IR thermography
[ONERA, TP NO. 1992-46] p 207 A92-48607

VENTILATION FANS

Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow
[ETN-92-91489] p 202 N92-29926

VENTING

Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds
[ESDU-92002-SUPPL.] p 51 N92-32782

VENUS ATMOSPHERE

The Venusan polar dipole p 285 A92-30456

VERTEBRAE

Spinal X-ray screening of high performance fighter pilots p 245 A92-15959

VERTICAL DISTRIBUTION

Feasibility study of hypersonic clinometric measurements at R3Ch
[ONERA-RSF-136/1865-AY-728-] p 48 N92-28789

VERTICAL LANDING

Requirements and possible technical solutions derived from the new airmobility concept of the German Army p 1 A92-14348

RAE Bedford VAAC research project --- VSTOL aircraft advanced flight control p 104 A92-40039

Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318

Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

ASTOVL combat aircraft design synthesis and optimization
[CRANFIELD-AERO-9201] p 88 N92-31515

VERTICAL ORIENTATION

Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDiF
[NLR-TR-88108-U] p 64 N92-19491

VERTICAL TAKEOFF

Requirements and possible technical solutions derived from the new airmobility concept of the German Army p 1 A92-14348

VERTICAL TAKEOFF AIRCRAFT

VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561

The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299

Blade instability of horizontally stoppable rotors p 106 A92-56308

Application of Eigenstructure Assignment to the control of powered lift combat aircraft
[RAE-TM-FS-1009] p 107 N92-12004

Aircraft ship operations
[AGARD-AR-312] p 85 N92-28468

The Eurofar program: An European overview on advanced VTOL civil transportation system
[MBB-UD-0611-91-PUB] p 58 N92-30418

VERY LARGE SCALE INTEGRATION

Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293

Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379

VERY LONG BASE INTERFEROMETRY

SETI in France
[IAF PAPER 92-1023] p 282 A92-57345

VHSC (CIRCUITS)

Implications of interoperability and standardization for the industrial base p 92 N92-14057

VIBRATION

Symposium on dynamic balancing p 221 N92-71104

VIBRATION DAMPING

Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815

A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development
[IAF PAPER 91-288] p 130 A92-14714

A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345

Generalized higher harmonic control - Ten years of Aerospace experience p 104 A92-35769

General model of isolated helicopter blade for stability investigation p 71 A92-35774

Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085

Elasto-acoustic damped vibrations - Finite element and modal reduction methods
[ONERA, TP NO. 1992-52] p 218 A92-48613

Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304

A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866

Influence of microvibrations on spacecraft performances p 134 N92-23825

Control concepts for active magnetic bearings p 214 N92-27743

VIBRATION EFFECTS

High enthalpy nozzle flows p 36 N92-15000

On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460

Symposium on dynamic balancing p 221 N92-71104

VIBRATION ISOLATORS

Control concepts for active magnetic bearings p 214 N92-27743

Active vibrations and noise control for turboprop application research program activities p 271 N92-32962

VIBRATION MEASUREMENT

Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398

The use of optical sensors and signal processing gas turbine engines p 90 A92-46247

Acoustic characteristics of anechoic chamber at FFA
[FFA-TN-1990-43] p 268 N92-12599

Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952

Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956

VIBRATION MODE

A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345

Simulation of helicopter see-saw rotor motion p 74 A92-56287

SCOPE dynamic analysis and frequency response using DISTEL software p 139 N92-70065

VIBRATION TESTS

Aircraft ground vibration test by means of flight control surfaces
[ONERA, TP NO. 1991-96] p 103 A92-16079

Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548

VISCOELASTICITY

A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891

Finite element simulation of viscoelastic flow p 205 N92-34038

VISCOPLASTICITY

Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles
[ONERA, TP NO. 1992-31] p 218 A92-48592

VISCOITY

Finite element methods for flow problems p 200 N92-27672

Continuous wavelet analysis of coherent structures p 203 N92-30673

VISCOUS DAMPING

Effect of viscous damping on the response of floating bodies p 187 N92-14303

VISCOUS DRAG

Drag prediction using computation methods
[ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682

SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods
[PB91-219444] p 52 N92-70249

VISCOUS FLOW

Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649

Solution of the Reynolds-averaged Navier-Stokes equations for transonic aeroflow flows p 6 A92-13198

Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815

The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology
[ASME PAPER 91-GT-124] p 8 A92-15569

Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results
[ASME PAPER 91-GT-126] p 8 A92-15571

An experiment on unsteady flow over an oscillating airfoil
[ASME PAPER 91-GT-181] p 8 A92-15613

Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455

Computational methods in viscous aerodynamics --- Book p 11 A92-21976

Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation
[ONERA, TP NO. 1991-235] p 168 A92-26386

Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461

Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466

Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029

The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143

Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172

Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600

A spectral model for turbulent transport p 178 A92-45095

Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions
[AIAA PAPER 92-2638] p 20 A92-45507

Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies
[AIAA PAPER 92-2704] p 21 A92-45546

Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839

Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918

Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056

Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511

A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028

On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124

Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface p 263 A92-54574

Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951

SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999

Verification and application of the NSFLEX method for hypersonic flow conditions p 36 N92-15005

Efficient solution of three-dimensional viscous hypersonic flows p 37 N92-15007

- Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014
- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 N92-15018
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 N92-15029
- Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 N92-17311
- Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231
- Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232
- VSIA: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323
- Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S-PUB/458/O] p 194 N92-21704
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466
- The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
- Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
- Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration [ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- The 2D-computation of an axial fan with FINFLO [PB92-180678] p 203 N92-30023
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB/FE211/S/PUB/466] p 204 N92-30674
- Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 N92-70561
- VISCOUS FLUIDS**
- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- VISIBILITY**
- SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
- Trial of a slant visual range measuring device p 210 N92-31043
- Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- VISUAL CONTROL**
- Approach and landing assisted by onboard image processing p 64 N92-21959
- VOICE COMMUNICATION**
- Electronically steerable antenna for aircraft p 156 N92-15272
- Implementation of Inmarsat mobile satcom systems p 157 N92-24073
- Future developments in aeronautical satellite communications p 158 N92-24167
- VON KARMAN EQUATION**
- A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891
- VORTEX ALLEVIATION**
- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
- VORTEX BREAKDOWN**
- The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
- Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477
- Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
- Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164
- Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 N92-11308
- Vortex Flow Aerodynamics [AGARD-CP-494] p 30 N92-12996
- Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 N92-13018
- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
- Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
- VORTEX FILAMENTS**
- The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
- Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
- A short or a long cylinder: What difference does it make to the Karman vortex street? [MPIS-98/1990] p 40 N92-17314
- Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
- VORTEX FLAPS**
- An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023
- Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing [CRANFIELD-AERO-9113-PT-1] p 40 N92-19679
- VORTEX GENERATORS**
- Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
- Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549
- Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
- Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- VORTEX SHEDDING**
- The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758
- Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045
- Separation and vortex formation in turbulent flows [ONERA, TP NO. 1992-7] p 24 A92-48579
- Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
- Effect of viscous damping on the response of floating bodies p 187 N92-14303
- A short or a long cylinder: What difference does it make to the Karman vortex street? [MPIS-98/1990] p 40 N92-17314
- Vorticity measurements in the near wake of a bluff body at low Reynolds numbers [AERO-REPT-9102] p 195 N92-22100
- VORTEX SHEETS**
- Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
- Secondary separation from a slender wing p 6 A92-13448
- Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
- From vortex layers to vortex sheets p 181 A92-50108
- The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 N92-18291
- A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193
- VORTEX STREETS**
- Numerical simulation of vortex street-edge interaction p 33 N92-13027
- VORTICES**
- Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- Topology of steady flows of low viscosity fluids p 162 A92-11219
- The enigmatic merging conditions of two-layer baroclinic vortices p 162 A92-11225
- Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
- Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
- Behavior of a suspension in the presence of a potential vortex [ONERA, TP NO. 1991-140] p 163 A92-16114
- Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
- The evaluation of canard couplings at high angles of attack [AIAA PAPER 92-0281] p 12 A92-25735
- Internal flow modelling of vortex throttles p 168 A92-27385
- Vortices on accretion disks p 284 A92-27396
- Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800
- Using Rankine vortices to model flow around a body of revolution p 169 A92-28061
- Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
- Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- The Venusian polar dipole p 285 A92-30456
- Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- High temperature superconducting vortex flow transistor p 159 A92-38971
- A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
- Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
- On the development of Goertler vortices in wall jet flow p 177 A92-44801
- Experimental investigation of vortex dynamics on delta wings [AIAA PAPER 92-2731] p 21 A92-45565
- Calculation of potential flow around airfoils using a discrete vortex method p 21 A92-45827
- Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
- Modeling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
- Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511
- Some problems of the stability of a system of three vortices p 182 A92-51893
- Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
- Insight into singular vortex flows p 183 A92-53052
- Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
- Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
- Measurements of the dynamic stall vortex convection speed p 27 A92-56351
- Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
- Superfluid vortex nucleation in He-3 flow p 271 N92-10479
- Dynamics of vortices in high-temperature superconductors p 273 N92-10501
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary [ONERA-RTS-21/4365-AY-056A] p 76 N92-11009
- Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 N92-11308
- SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
- Vortex Flow Aerodynamics [AGARD-CP-494] p 30 N92-12996
- Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997
- Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 N92-12998
- Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000
- Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003
- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
 An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
 Characteristics of a boundary layer in a leading edge vortex p 31 N92-13012
 Vortex flow on a missile body: Experimental study and modeling p 32 N92-13013
 Asymmetric vortex flow over circular cones p 32 N92-13014
 An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 N92-13015
 Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 N92-13018
 On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
 Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022
 Numerical simulation of vortex street-edge interaction p 33 N92-13027
 Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
 The turbomachine blading design using S2-S1 approach p 97 N92-13940
 A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
 Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 N92-14328
 The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
 A short or a long cylinder: What difference does it make to the Karman vortex street? p 40 N92-17314
 [MPIS-98/1990] Investigation on the control of a Karman vortex street [MPIS-99/1990] p 40 N92-17315
 The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 N92-18291
 Numerical solutions for uniform flow around symmetrical bodies using panel methods [AERO-REPT-9014] p 192 N92-18320
 Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793
 The 8th Symposium on Turbulent Shear Flows: Volume 2: 19-31, poster sessions. [AD-A243810] p 192 N92-18934
 Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
 Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317
 Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds p 41 N92-20498
 [NLR-TP-90029-U] Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 N92-21763
 Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773
 Boundary layer transition on concave surfaces p 195 N92-22200
 Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788
 Ultrasonic investigation of (3)He-A vortices in low magnetic fields p 265 N92-23865
 [PB92-142256] Turbulence modelling in CFD: Present status, future prospects p 197 N92-24515
 A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
 Vortex dynamics in artificially fabricated superconducting networks [ETN-92-91296] p 160 N92-25307
 Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
 Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
 The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
 Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507
 Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304

A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 N92-29972
 Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 N92-29977
 A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
 A subgrid-scale model based on the second-order velocity structure function p 203 N92-30651
 Continuous wavelet analysis of coherent structures p 203 N92-30673
 Vortex flow aerodynamics [AGARD-AR-299] p 50 N92-30947
 Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
 Pressure field developed by the random movement of the vortices near a wall [ETN-92-91665] p 204 N92-32770
 Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow [PB92-138718] p 53 N92-70577
VORTICITY
 Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
 An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
 Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196
 Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
 Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation [ONERA, TP NO. 1991-235] p 168 A92-26386
 A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574
 A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
 Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
 A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
 Flow structure and mixing in obstructed and confined jets p 174 A92-40107
 Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
 Separation and vortex formation in turbulent flows [ONERA, TP NO. 1992-7] p 24 A92-48579
 The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
 Some problems of the stability of a system of three vortices p 182 A92-51893
 Numerical simulation of unsteady rotor wakes p 27 A92-56352
 Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 N92-12219
 On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
 Numerical simulation of vortex street-edge interaction p 33 N92-13027
 The turbomachine blading design using S2-S1 approach p 97 N92-13940
 Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
 Vorticity measurements in the near wake of a bluff body at low Reynolds numbers [AERO-REPT-9102] p 195 N92-22100
 Applications of boundary integral methods to the study of steep free surface waves p 195 N92-23149
 Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
 Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 N92-29977
 The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048
VORTICITY EQUATIONS
 Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
 The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
 On the relation between total ozone and meteorology p 236 A92-27796

Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228
 Local error growth in a barotropic model p 239 A92-52941
 The interaction between a high-frequency gust and a blade row p 267 A92-54484
 The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
 Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
 Stochastic perturbed systems: Theory and practice of Karman vortex streets [MPIS-4/1991] p 193 N92-20180

W

WAKES

Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
 Numerical simulation of unsteady rotor wakes p 27 A92-56352
 Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997
 Drag prediction using computation methods [ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682
 Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955
 Vorticity measurements in the near wake of a bluff body at low Reynolds numbers [AERO-REPT-9102] p 195 N92-22100
 A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193

WALL FLOW

Blade defect force investigation in a compressor cascade p 6 A92-13233
 Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822
 Noise-driven flow p 10 A92-18680
 The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
 Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
 A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
 Progress and paradoxes in modelling near-wall turbulence p 174 A92-40158
 On the development of Goertler vortices in wall jet flow p 177 A92-44801
 The nonlinear stability of flows over compliant walls p 179 A92-46265
 Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297
 Computational modelling of turbulent flow in S-bends p 199 N92-27480
 Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TR-88072-U] p 49 N92-29884
 A subgrid-scale model based on the second-order velocity structure function p 203 N92-30651
 Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 N92-32734
 Pressure field developed by the random movement of the vortices near a wall [ETN-92-91665] p 204 N92-32770
 Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
 Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions [PB92-138577] p 118 N92-70574

WALL PRESSURE

Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustic method [ONERA, TP NO. 1991-212] p 13 A92-26364
 Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 N92-11979
 Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures [DLR-FB-91-09] p 113 N92-12005
 Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235
 Flat plates placed in depleted hypersonic flow [SESSIA-430/91-960] p 50 N92-31508
 Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions [PB92-138577] p 118 N92-70574

WALL TEMPERATURE

- Effect of model cooling on periodic transonic flow
p 22 A92-46900
- Boundary layer transition
[CERT-RTS-55/5018-45] p 186 A92-12210

WARFARE

- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 A92-19000
- Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 A92-27888

WARNING SYSTEMS

- Innovation in the laser warning sensor field p 89 A92-35742
- On the optimization of windshear warning and guidance systems p 57 A92-29703
- [NLR-TP-90196-U] p 57 A92-29703
- Examination of aircraft warning and caution lights after shock testing p 58 A92-30474
- [NLR-TP-89284-U] p 58 A92-30474

WASTE ENERGY UTILIZATION

- Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315

WASTE TREATMENT

- Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 A92-26977

WATER CURRENTS

- On the determination of turbulent mixing coefficients from Eulerian current data p 195 A92-22121

WATER FLOW

- The laminar natural convection on a horizontal surface [AERO-REPT-9015] p 191 A92-18236
- Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 A92-30372

WATER TUNNEL TESTS

- Topology of steady flows of low viscosity fluids p 162 A92-11219
- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 A92-13021

WATER VAPOR

- Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
- Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 A92-70048

WATER WAVES

- Simulations of SAR imaging of ship wakes, comparing different wind growth rate models p 242 A92-35025
- Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097

WAVE DRAG

- Inviscid drag prediction for transonic transport wings using a full-potential method p 41 A92-20473
- [NLR-TP-89365-U] p 41 A92-20473
- Wave drag determination in the transonic full-potential flow code MATRICS [NLR-TP-90062-U] p 47 A92-28709

WAVE EQUATIONS

- Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 A92-18089
- Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 A92-18234
- Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 A92-18340

WAVE FRONTS

- Wavelet transforms and their applications to turbulence p 177 A92-45091

WAVE INTERACTION

- Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228
- Upper/lower vortex interaction and potential vorticity inversion p 233 A92-26331

WAVE PROPAGATION

- Noise-driven flow p 10 A92-18680
- Propagation of shock waves through clouds [AERO-REPT-9104] p 191 A92-18317
- Applications of boundary integral methods to the study of steep free surface waves p 195 A92-23149

WAVERIDERS

- Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748

WEAPON SYSTEMS

- Status and user characterization of parallel machines for digital simulation p 260 A92-23046
- The other missiles p 2 A92-28184

- The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 A92-14046
- Load monitoring of F-16 A/B aircraft of the RNLAf with a smart electronic device p 78 A92-18583
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 A92-28541

WEATHER

- Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 A92-21679
- Flight in adverse environmental conditions p 55 A92-21680
- Integration of flight and carrier landing aid systems for shipboard operations p 64 A92-21958
- Airborne lidar and radiometric observations of PBL and low clouds p 240 A92-31037

WEATHER FORECASTING

- Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
- Shear progress --- wind shear handling and recognition technologies for aviation p 3 A92-40880

WEDGE FLOW

- Navier-Stokes computation over a three-dimensional ramp [ONERA, TP NO. 1992-55] p 181 A92-48616

WEIGHT REDUCTION

- The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- Aspects of compression in aerospace composites: Future requirements p 146 A92-33036

WEIGHTLESSNESS

- The weightless experience p 245 A92-16403
- Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704
- Gravity effects on reproduction, development, and aging p 244 A92-34193

WHISKER COMPOSITES

- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337

WIND (METEOROLOGY)

- How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607
- The e-beam sustained laser technology for space-based Doppler wind lidar p 240 A92-29300

WIND DIRECTION

- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 A92-21955

WIND EFFECTS

- Estimation of airborne performance in landing [ESDU-91032] p 77 A92-15988

WIND MEASUREMENT

- Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 A92-29213
- The e-beam sustained laser technology for space-based Doppler wind lidar p 240 A92-29300
- On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 A92-29703

WIND PROFILES

- Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
- Space activities in Italy p 121 A92-53457

WIND SHEAR

- Aircraft control for take-off in windshear p 104 A92-36990
- Shear progress --- wind shear handling and recognition technologies for aviation p 3 A92-40880
- Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft p 105 A92-47784
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988 [AD-A246775] p 243 A92-28365
- On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 A92-29703

WIND TUNNEL APPARATUS

- Recent development of wind-tunnel test techniques at ONERA [ONERA, TP NO. 1991-135] p 110 A92-16110
- Productivity and quality in the Modane and Fauga wind tunnels - Prospects for the 90s [ONERA, TP NO. 1991-203] p 111 A92-26360

WIND TUNNEL DRIVES

- An overview of the planned aerospace test facilities at Capua, Italy [AIAA PAPER 92-3944] p 112 A92-56773

WIND TUNNEL MODELS

- A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345

- Recent development of wind-tunnel test techniques at ONERA [ONERA, TP NO. 1991-135] p 110 A92-16110
- Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450
- Conception of a UHB engine simulator for the essential characteristics of a true-scale engine --- ultrahigh bypass p 112 A92-54322
- Model incidence measurement using SAAB ELOPTOPOS system [NLR-TP-89182-U] p 115 A92-18416
- Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 A92-27804

- LAH-main rotor model test at the DNW [NLR-TP-90305-U] p 87 A92-28687

- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program [PB92-138676] p 53 A92-70590

WIND TUNNEL NOZZLES

- SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 A92-14999

WIND TUNNEL TESTS

- Topology of steady flows of low viscosity fluids p 162 A92-11219
- Automation of the measurement process in the N2 wind tunnel with the SPITA M-3 system p 110 A92-12347
- A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345
- Recent development of wind-tunnel test techniques at ONERA [ONERA, TP NO. 1991-135] p 110 A92-16110
- Detailed analysis of wing-nacelle interaction for commercial transport aircraft [ONERA, TP NO. 1991-152] p 9 A92-16122
- The application of high pressure ejectors to reaction control systems p 93 A92-16666
- Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450
- Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
- Productivity and quality in the Modane and Fauga wind tunnels - Prospects for the 90s [ONERA, TP NO. 1991-203] p 111 A92-26360
- Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method [ONERA, TP NO. 1991-212] p 13 A92-26364
- Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel [ONERA, TP NO. 1991-219] p 111 A92-26371
- Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
- The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum p 15 A92-32323
- EUROFAR airframe aerodynamic design p 70 A92-35750
- LAH main rotor model test at the DNW p 70 A92-35771
- Design and manufacturing of torsional flexible blade models p 71 A92-35780
- Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
- Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
- Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093
- Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045
- Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
- New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- A new optical pressure measurement system (OPMS) p 208 A92-54303
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336

- BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
- The SR3 low density wind tunnel - Facility capabilities and research development p 112 A92-56798
- [AIAA PAPER 92-3972] p 112 A92-56798
- Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions p 75 A92-56809
- [AIAA PAPER 92-3985] p 75 A92-56809
- Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel p 209 A92-56826
- [AIAA PAPER 92-4003] p 209 A92-56826
- Application of infrared thermography to thermal flux measurement in wind tunnels p 112 A92-11020
- [AAAF-NT-89-12] p 112 A92-11020
- Thermographic gust wind tunnel measurements p 29 A92-11972
- [ONERA-RF-31/3409-PY] p 29 A92-11972
- Flat planes in rarefied hypersonic flows p 29 A92-11979
- [SESSIA-430/91-940] p 29 A92-11979
- Nonstationary flight aerodynamics in a turbulent environment p 29 A92-11980
- [ETN-91-90102] p 29 A92-11980
- Control aspects of the transition from transversal to transonic flow, step effects p 29 A92-11981
- [ETN-91-90106] p 29 A92-11981
- Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow p 29 A92-11982
- [REPT-90/59] p 29 A92-11982
- Study of interactions on anemoclinometric sensors p 113 A92-12006
- [REPT-90/30] p 113 A92-12006
- Vortex flow on a missile body: Experimental study and modeling p 32 A92-13013
- An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 A92-13015
- Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 A92-13022
- An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 A92-13023
- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 A92-14991
- Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 A92-15012
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 A92-15017
- Aerodynamic development of the X-31 aircraft for the high angle of attack region p 77 A92-17313
- [MBB-FE211-S-PUB-452] p 77 A92-17313
- A short or a long cylinder: What difference does it make to the Karman vortex street? p 40 A92-17314
- [MPIS-98/1990] p 40 A92-17314
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 A92-17853
- Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 A92-18782
- Characterization of unsteady aerodynamic phenomena at high angles p 80 A92-18787
- X-31: Discussion of steady state and rotary derivatives p 81 A92-18789
- Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 A92-18790
- Dynamic wind tunnel tests on control of forebody vortices with suction p 107 A92-18793
- Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing p 40 A92-19679
- [CRANFIELD-AERO-9113-PT-1] p 40 A92-19679
- Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests p 115 A92-20385
- [ONERA-RSF-128/1865-AY-726A] p 115 A92-20385
- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 A92-21693
- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 A92-21955
- Separation of relaminarised boundary layers p 195 A92-22209
- [CUED/A-AERO/TR-16] p 195 A92-22209
- Survey of experimental techniques for performance prediction p 84 A92-23954
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 A92-24343
- Comparison of LDA and LTA applications for propeller tests in wind tunnels p 47 A92-28658
- [NLR-MP-88031-U] p 47 A92-28658
- The windtunnel as a tool for laminar flow research p 117 A92-28661
- [NLR-TP-90305-U] p 87 A92-28667
- Feasibility study of hypersonic clinometric measurements at R3Ch p 48 A92-28789
- [ONERA-RSF-136/1865-AY-728-] p 48 A92-28789
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model p 48 A92-29159
- [ESA-TT-1247] p 48 A92-29159
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference p 49 A92-29884
- [NLR-TR-88072-U] p 49 A92-29884
- Flat plates placed in depleted hypersonic flow p 50 A92-31508
- [SESSIA-430/91.960] p 50 A92-31508
- Integration of wall interference assessment and wall adaptation p 118 A92-32734
- [NLR-TP-91119-U] p 118 A92-32734
- Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level p 204 A92-32765
- [ETN-92-92088] p 204 A92-32765
- Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements p 52 A92-32800
- [ONERA-RT-47/1147-AY-146A-P] p 52 A92-32800
- Flutter models: Their design, manufacture, and ground testing p 109 A92-34164
- Unsteady wind tunnel tests p 109 A92-34166
- Selection of a laser anemometer technique for propeller tests in wind tunnels p 118 A92-70563
- [PB92-138510] p 118 A92-70563
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program p 53 A92-70590
- [PB92-138676] p 53 A92-70590
- LARVE: A hypersonic flight test facility launched by Ariane 4 p 118 A92-70983
- [PB92-138726] p 118 A92-70983
- WIND TUNNEL WALLS**
- Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675
- Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures p 113 A92-12005
- [DLR-FB-91-09] p 113 A92-12005
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference p 49 A92-29884
- [NLR-TR-88072-U] p 49 A92-29884
- Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions p 118 A92-70574
- [PB92-138577] p 118 A92-70574
- WIND TUNNELS**
- Aerospace technology: Technical data and information on foreign test facilities p 113 A92-13076
- [GAO/NSIAD-90-71FS] p 113 A92-13076
- The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 A92-15009
- CFD contributions during hypersonic airplane intake design p 199 A92-27472
- Turbulent spot generation and growth rates in a transonic boundary layer p 202 A92-29118
- [AD-A250221] p 202 A92-29118
- WIND TURBINES**
- Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044
- Mechanical noise from large wind turbines - Experiences from Swedish prototypes p 226 A92-39046
- Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- WIND VARIATIONS**
- An investigation of cold overflow over the Iceland/Faeroes Ridge p 242 A92-17169
- [AD-A243084] p 242 A92-17169
- WIND VELOCITY**
- The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 A92-17853
- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 A92-21955
- WIND VELOCITY MEASUREMENT**
- Sodar wind speed profiles over forested boundary layer during the Hapex-Mobilhy campaign p 235 A92-17729
- Potential applications of laser Doppler anemometry for in-flight measurements p 92 A92-28654
- [NLR-TP-90163-U] p 92 A92-28654
- WINDSHIELDS**
- Windscreens departure p 55 A92-42500
- WING FLAPS**
- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- WING FLOW METHOD TESTS**
- Control aspects of the transition from transversal to transonic flow, step effects p 29 A92-11981
- [ETN-91-90106] p 29 A92-11981
- WING LOADING**
- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- Monitoring load experience of individual aircraft p 77 A92-15065
- [NLR-TP-90084-U] p 77 A92-15065
- WING NACELLE CONFIGURATIONS**
- Detailed analysis of wing-nacelle interaction for commercial transport aircraft p 9 A92-16122
- [ONERA, TP NO. 1991-152] p 9 A92-16122
- WING OSCILLATIONS**
- Nonstationary flight aerodynamics in a turbulent environment p 29 A92-11980
- [ETN-91-90102] p 29 A92-11980
- Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 A92-18786
- WING PANELS**
- Nonstationary flight aerodynamics in a turbulent environment p 29 A92-11980
- [ETN-91-90102] p 29 A92-11980
- Global/local interlaminar stress analysis of a grid-stiffened composite panel p 221 A92-33139
- [NASA-CR-190822] p 221 A92-33139
- WING PLANFORMS**
- Numerical simulation of vortex flows past impulsively started wings p 33 A92-13028
- Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds p 51 A92-32782
- [ESDU-92002-SUPPL] p 51 A92-32782
- WING PROFILES**
- Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
- EUROFAR airframe aerodynamic design p 70 A92-35750
- Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile p 185 A92-11307
- [CERT-RT-65/5604-35] p 185 A92-11307
- Maximum lift of wings with trailing-edge flaps at low speeds p 28 A92-11970
- [ESDU-91014] p 28 A92-11970
- Control aspects of the transition from transversal to transonic flow, step effects p 29 A92-11981
- [ETN-91-90106] p 29 A92-11981
- Research on inverse methods and optimization in Italy p 97 A92-13956
- System for transonic wing design with geometric constraints based on an inverse method p 53 A92-70576
- [PB92-138692] p 53 A92-70576
- WING TIP VORTICES**
- The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 A92-13021
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 47 A92-28657
- [NLR-TP-90368-U] p 47 A92-28657
- WING TIPS**
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary p 76 A92-11009
- [ONERA-RTS-21/4365-AY-056A] p 76 A92-11009
- WINGED VEHICLES**
- Open and closed loop guidance for an airbreathing winged launch vehicle p 127 A92-55537
- [IAF PAPER 92-0042] p 127 A92-55537
- WINGS**
- Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
- Lift-curve slope of wing-body combinations p 28 A92-11968
- [ESDU-91007] p 28 A92-11968
- Review of aerodynamic design in the Netherlands p 76 A92-13929
- Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 A92-13951
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 A92-21692
- A theoretical investigation of the induced drag of wing of finite aspect ratio p 43 A92-22193
- [CUED/A-AERO/TR-17(1991)] p 43 A92-22193
- The structural optimization system OPTSYS: Current status and applications p 83 A92-23232
- Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 A92-23238

The icing of the wing upper side and bottom side of the icing research aircraft of the DLR

p 57 N92-26349

Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis

p 44 N92-27940

Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations

p 45 N92-27945

Computation of viscous phenomena in unsteady transonic flow

p 46 N92-27949

Transonic aeroelastic calculations in both the time and frequency domains

p 46 N92-27950

A review of scale effects on surfaces in unsteady motion

p 46 N92-27962

Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects

[NLR-TP-90184-U] p 201 N92-28694

Analysis of three icing test flights reaching the aircraft-referred icing degree of severe

[ESA-TT-1254] p 58 N92-31943

Aerodynamic centre of wing-body combinations

[ESDU-92024] p 50 N92-32479

Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds

[ESDU-92002-SUPPL] p 51 N92-32782

SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods

[PB91-219444] p 52 N92-70249

WINTER

Experiences during a 14 months overwintering with respect to potential human habitation on other planets

[IAF PAPER 92-0249] p 244 A92-55688

A note on the interannual variability of the polar vortex in the Arctic

p 233 N92-24659

WIRE

Magnetic suspension using high temperature superconducting cores

p 161 N92-27789

WORDS (LANGUAGE)

Some new definitions for the Multilingual Terminology Data Base

[IAF PAPER 92-0359] p 277 A92-55766

WORK-REST CYCLE

Vigilance in transport operations - Field studies in air transport and railways

p 249 A92-11173

WORKING FLUIDS

Concept of a one-dimensional model of the dynamic behavior of a gas turbine

p 96 A92-47791

WORKLOADS (PSYCHOPHYSIOLOGY)

Vigilance in transport operations - Field studies in air transport and railways

p 249 A92-11173

The development of a working model of flight crew underload

p 249 A92-13019

Heart rate variability as an index for pilot workload

p 246 A92-45012

Integrated flight control systems - Architectural considerations for future aircraft concepts

p 104 A92-45322

WORKSTATIONS

Interactive visualization of CFD results ASCETE

p 190 N92-16235

Mikado: A graphic program

p 190 N92-16237

X

X RAY ANALYSIS

Spinal X-ray screening of high performance fighter pilots

p 245 A92-15959

X RAY SPECTROSCOPY

Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre

p 150 A92-36292

The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma

p 140 N92-10563

X-30 VEHICLE

Hypersonic materials

p 143 A92-18002

XV-15 AIRCRAFT

Short takeoff optimization for the XV-15 tiltrotor aircraft

p 74 A92-56302

Y

YAG LASERS

Theoretical simulation of a 2 micron airborne solid state laser anemometer

p 210 N92-31059

YAW

An investigation into the interface between three closely spaced axi-symmetric bodies at subsonic speed

[CRANFIELD-AERO-9114] p 50 N92-31514

YAWING MOMENTS

Contribution of fin and tailplane to sidelforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack

[ESDU-91031]

p 39 N92-15971

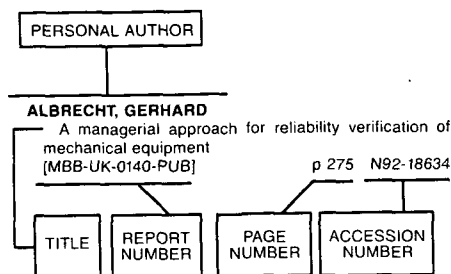
Z

ZONAL FLOW (METEOROLOGY)

The upper atmosphere as sensed by satellite orbits

p 230 A92-30638

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence.

A

- AAKJAER, PETER D.**
Polar lows affecting Denmark p 237 A92-32491
- ABADIE, G.**
Use of relative humidity sensors for planes measurement p 89 A92-32080
- ABBOTT, W.**
Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- ABENSUR, T.**
Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
Management of navigation means failure in Hermes space vehicle p 136 A92-24467
- ABGRALL, R.**
Numerical simulations around models in hypersonic wind tunnels p 36 A92-14998
- ABOU-HAIDAR, N. I.**
Computational modelling of turbulent flow in S-bends p 199 A92-27480
- ABRAMOWICZ, M. A.**
Vortices on accretion disks p 284 A92-27396
- ABSIL, L. H. J.**
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 A92-14004
- ACHARD, J.-L.**
An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
- ACKROYD, J. A. D.**
Sydney Goldstein FRS Hon FRAES: An appreciation [AERO-REPT-8903] p 286 A92-17928
- ADAM, V.**
On board planning of 4D-trajectories p 66 A92-27897
- ADAM, VOLKMAR**
Testing of an experimental FMS p 85 A92-25596
- ADVANI, S. K.**
The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 A92-28579
- AFOLTER, H.**
Separation of external stores: Comparison of results [F+W-TF-2058] p 85 A92-26944

- AHMAD, Z.**
Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645
- AHMED, S. R.**
Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- AHO, JUHANI**
Injuries associated with the use of ejection seats in Finnish pilots p 247 A92-50292
- AINSCOW, K.**
Evolution of ASTOVL aircraft design p 72 A92-45311
Some implications for advanced STOVL operation from invincible class ships p 82 A92-21971
- AINSWORTH, R. W.**
An Axial Turbobrake [ASME PAPER 91-GT-1] p 211 A92-15501
- AJDARI, E.**
Computation of thermal radiation on spacecraft with mobile parts p 259 A92-25848
- AKKERMAN, E. M.**
Control of blood pressure in humans under microgravity p 248 A92-23071
- ALAPHILIPPE, M.**
Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728-] p 48 A92-28789
- ALATI, LORETO**
A new optical pressure measurement system (OPMS) p 208 A92-54303
- ALBER, HANS-DIETER**
Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 A92-12219
- ALBERTOZZA, L.**
Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104
- ALBONE, C. M.**
Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034
- ALBRECHT, GERHARD**
A managerial approach for reliability verification of mechanical equipment [MBB-UK-0140-PUB] p 275 A92-18634
- ALBUS, J.**
Determination of the structural weight of spacecraft p 135 A92-24387
- ALDAMIZ, A.**
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
- ALDER, MARTIN**
British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023
- ALEXANDRE, A.**
Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 A92-26974
- ALF, M.**
The transpirator, an efficient and light evaporative cooler for space technology p 154 A92-26986
- ALFREDSSON, P. H.**
Transition to turbulence in curved channel flow p 18 A92-40125
- ALLAN, WILLIAM D. E.**
Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 A92-12203
- ALLARD, D. W.**
ETOPS: A developing scene [PNR-90844] p 98 A92-20459
- ALLEGRE, J.**
The SR3 low density wind tunnel - Facility capabilities and research development [AIAA PAPER 92-3972] p 112 A92-56798
Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 A92-11979
Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 A92-14995
Flat plates placed in depleted hypersonic flow [SESSIA-430/91-960] p 50 A92-31508
- ALLEN, C. B.**
An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- ALLEN, H. R.**
A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574
- ALLWOOD, R. J.**
Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548
- ALMAR, I.**
An attempt to unify space terminology - The Multilingual Terminology Data Base [IAF PAPER 92-0343] p 277 A92-55758
Some new definitions for the Multilingual Terminology Data Base [IAF PAPER 92-0359] p 277 A92-55766
- ALPERINE, S.**
Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
- ALSOP, C.**
The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- ALVARO, M.**
Application of eddy current techniques to graphite composite materials [ETN-92-90815] p 145 A92-21416
- ALZIARY, T.**
Hypersonic wakes [ETN-92-91082] p 41 A92-19925
- ALZIARYDEROQUEFORT, T.**
Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
- AMABLE, P.**
Proposal for the new fatigue management system for the AMX p 78 A92-18580
- AMANI, G.**
Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
- AMATO, M.**
Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
- AMBROSIUS, B. A. C.**
Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949
- ANAGNOSTOPOULOS, J. S.**
Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study p 178 A92-45603
- ANCILLOTTO, E.**
Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 A92-20611
- ANDERSEN, BO N.**
The Norwegian sounding rocket and balloon programme p 122 A92-24594
- ANDERSEN, HARALD T.**
Spinal X-ray screening of high performance fighter pilots p 245 A92-15959
- ANDERSEN, T.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- ANDERSSON, H. I.**
Spin-up in a semicircular cylinder p 184 A92-56123
- ANDREWS, HAROLD**
Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 A92-27870
- ANGEL, R. G. A.**
Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323
- ANGELIDIS, DIOGENES**
Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
- ANNE, J. C.**
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 A92-25679

ANQUEZ, L.

Innovative constituents requirements to improve composites compressive strength p 146 N92-33043

ANSART, D.

CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376

ANSELL, HANS

A manufacturer's approach to ensure long term structural integrity p 57 N92-30133

ANSELMET, F.

Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128

ANTON, FELIX L.

Aircraft financing in Spain p 280 A92-35593

ANTONUTTO, G.

Blood lactate during leg exercise in microgravity p 247 A92-50162

APEL, UWE

Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842

APICELLA, A.

The G-222 aircraft individual tracking programme p 78 N92-18582

APKARIAN, PIERRE

Double loop control law strategy and applications to helicopter [CERT-2/7724-DEIRA] p 108 N92-19295

ARDONCEAU, P.

Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
Nonstationary flight aerodynamics in a turbulent environment [ETN-91-90102] p 29 N92-11980

ARDUINI, C.

A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527

ARECCHI, F. T.

Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891

ARMANDO, A.

AM-X flight simulator from engineering tool to training device p 116 N92-28536

ARNAL, D.

The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210
Hypersonic boundary layers: Transition and turbulence effects p 188 N92-14976
Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711

ARNOLD, F.

Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances p 232 A92-55441

ARNOLD, NEIL F.

Tracer transport in the middle atmosphere p 229 N92-26473

ARNOLD, U.

Blade instability of horizontally stoppable rotors p 106 A92-56308

ARNONE, A.

Transonic cascade flow prediction using the Navier-Stokes equations [ASME PAPER 91-GT-313] p 8 A92-15690

ARNONE, ANDREA

Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523

ARRIBAS, M.

Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728

ARRIGONI, NICOLA

Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548

ARTIGUES, C.

International standardisation of regulations for gust loading calculations p 68 A92-22473

ARTS, TONY

Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 N92-24343

ARULIAH, A. L.

Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629

ARVA, PER

Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405

ASENSIO, A.

New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238

ASHDOWN, A. M.

Software methodologies for safety critical systems p 257 N92-12467

ASKOVIC, R.

An approximate method for treating a turbulent boundary layer with symmetry of revolution p 164 A92-21306

ASLAKSEN, T. K.

Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800

ASSIE, JEAN-PIERRE

Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118

ASTOR, J.-L.

Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762

ATKIN, C. J.

A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55 p 14 A92-28006

ATKINSON, K. N.

Computations of a separated turbulent boundary layer p 174 A92-40131

AUPOIX, B.

Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839

Models of turbulence in a hypersonic boundary layer p 19 A92-41817

Hypersonic boundary layers: Transition and turbulence effects p 188 N92-14976

A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 N92-19294

AUWETER-KURTZ, M.

Plasma thruster development program at the IRS [IAF PAPER 92-0610] p 141 A92-57061

The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009

AYACHE, P.

SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859

AYMERDELACHEVALERIE, D.

Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 N92-15002

AYRES, J. C.

Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233

B

BACKSTROM, M. G.

The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136

BADCOCK, K. J.

A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300

BAEDER, J. D.

Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors [ONERA, TP NO. 1991-178] p 10 A92-16140

BAI, X. S.

Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967

BAILEY, P. J.

Impinging jets in cross-flow p 169 A92-28942

The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324

BAILLEUX, P.

Study of interactions on anemoclinometric sensors [REPT-90/30] p 113 N92-12006

BAIOCCO, P.

A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527

BAKER, J. R.

The UK element of the Maestro-1 SAR campaign p 223 A92-44167

BAKER, S. J.

Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102

BALAGEAS, D.

Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020

BALAGEAS, D. L.

Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450

Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430

Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003

Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

BALAKUMAR, P.

On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655

BALMA, M.

Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315

BALMINO, GEORGES

Gravity field data products from the Aristoteles mission p 224 N92-23925

BALOGH, A.

Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412

BALOIS, JEAN-YES

Aircraft simulations of the POLDER experiment: First results p 223 N92-11471

BANGUI, F.

Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 N92-10989

BANNINK, W. J.

Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001

BARAT, MICHEL

From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368

BARATA, J. M. M.

Turbulent energy budgets in impinging zones p 17 A92-40081

The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676

BARBER, R. W.

Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511

BARBERIS, D.

Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800

BARBERO, J.

Electronically steerable antenna for aircraft p 156 N92-15272

BARBIER, BRUNO

Concept for future cockpits p 88 A92-16148

BARILLOT, P.

Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977

BARKER, J. C.

Lynx - A 50 year product? p 75 A92-56307

BARKMEIJER, JAN

Local error growth in a barotropic model p 239 A92-52941

BARMIN, I. V.

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

BARNES, A. G.

Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315] p 118 N92-30769

BARON, A.

Numerical simulation of unsteady rotor wakes p 27 A92-56352

Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028

BARRE, S.

Hot-wire measurements in turbulent transonic flows p 26 A92-53078

BARRESI, G.

LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468

GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 N92-24443

- BARRETT, JONATHAN**
CAAC Guangzhou hijacking - Insurance issues
p 281 A92-43549
- BARRETT, R. V.**
The evaluation of canard couplings at high angles of attack
[AIAA PAPER 92-0281] p 12 A92-25735
- BARRIE, DOUGLAS**
Dornier Do.328 special - Examining the high-speed commuter
p 67 A92-11882
Heavy metal p 110 A92-18100
Assembling the future p 3 A92-44895
- BARSON, JOHN V.**
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 N92-19013
- BARTELD, G.**
Ageing aircraft research in the Netherlands
p 57 N92-30129
- BARTELS-LENNHOFF, H.-H.**
Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
- BARTHELEMY, J. P.**
Organization and technical status of the NH90 European helicopter programme p 4 A92-56306
- BARTOLI, A.**
Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
- BASDEVANT, CLAUDE**
Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
- BASSANINI, P.**
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
- BASSI, F.**
Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes
[ASME PAPER 91-GT-312] p 8 A92-15689
Numerical computations of transonic flows through cascades
[AIAA PAPER 92-3041] p 24 A92-48702
- BASSNER, H.**
High energy propulsion units for the year 2000
[ETN-92-90989] p 129 N92-20249
- BASSOM, ANDREW P.**
Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
- BATTEN, S.**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- BATTRICK, B.**
Aerothermodynamics for Space Vehicles
[ESA-SP-318] p 33 N92-14973
Catalogue of ESA patents
[ESA-SP-1131-REV-1] p 287 N92-19411
The Reentry of Salyut-7/Kosmos-1686
[ESA-SP-345] p 134 N92-23967
- BAUDIN, D.**
Vortex flow on a missile body: Experimental study and modeling p 32 N92-13013
- BAUDOIN, A.**
The French space program for earth observation p 222 A92-37154
- BAUDOIN, C.**
CARS temperature measurements and validation of a computing code on a gas-turbine combustor
[ONERA, TP NO. 1991-224] p 94 A92-26376
- BAULD, N. R., JR.**
Global/local interlaminar stress analysis of a grid-stiffened composite panel
[NASA-CR-190822] p 221 N92-33139
- BAUMANN, P.**
Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence
[ONERA, TP NO. 1991-94] p 206 A92-16077
Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring
[AAAF-NT-89-28] p 185 N92-11288
Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests
[ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
- BAX, JAN-HEIN**
Eurocontrol - UK detention rights p 280 A92-33048
- BAXENDALE, P. J.**
An aerodynamic consideration of the re-entry and aerobraking environment of space vehicles
[IAF PAPER ST-92-0017] p 27 A92-57363
- BAXTER, V. D.**
Heat pump systems with direct expansion ground coils
[DE92-007831] p 195 N92-23120
- BAYAR, K. C.**
Numerical simulation of vortex street-edge interaction p 33 N92-13027
- BAYDAR, E.**
Laminar channel flow over a square step p 180 A92-48254
- BEAGLEY, STEPHEN REUBEN**
The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
- BEAUFILS, J. Y.**
Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
- BEAUFUME, P.**
Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- BEAUSSANT, RAYMOND**
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- BECKER, A.**
DME growth elements and their use with MLS p 62 N92-14018
Testing concept of a movement area guidance p 65 N92-25597
- BECKER, F.**
Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124
- BECKER, JUERGEN**
Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795
- BECKER, U.**
Unmanned orbital servicing - From ground tests to in-orbit demonstration
[IAF PAPER 92-0780] p 122 A92-57189
- BECKETT, PETER**
Effective cueing during approach and touchdown: Comparison with flight p 117 N92-28552
- BECKHAM, ROBERT W.**
Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661
- BEHRMANN, H.**
Passive optical and IR sensors
[MBB-UH-HE512] p 224 N92-23392
- BEKAERT, G.**
A heat switch for space cryocooler applications p 160 N92-25852
- BELCHER, GORDON**
Validation of flight critical control systems
[AGARD-AR-274] p 108 N92-20026
- BELLOMO, N.**
Fluid dynamic forces on tethered satellite systems p 124 A92-52738
- BELYAVIN, A.**
Pilot attitudes to cockpit automation p 250 A92-44926
- BENCHERIF, L.**
The turbomachine blading design using S2-S1 approach p 97 N92-13940
- BENCHERIFA, B.**
Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
- BENEDETTO, D.**
From vortex layers to vortex sheets p 181 A92-50108
- BENELMOSTAFA, Y.**
Dispersion curves analysis for bonded plates at low F_d p 217 A92-13540
- BENES, A.**
Criticality management in space programs p 275 N92-18619
- BENHALILOU, M.**
Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
- BENHAMOU, PHILIPPE**
From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot
[ONERA, TP NO. 1991-216] p 260 A92-26368
- BENOCCI, C.**
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] p 188 N92-14328
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors
[VKI-TN-178] p 269 N92-21237
- BENOIT, J. P.**
Experimental and theoretical investigation of a homogeneous turbulent shear flow
[ONERA, TP NO. 1992-43] p 180 A92-48604
- BENTZEN, JOACHIM F.**
No end to incidents in airspace? III p 53 A92-23172
- BENZ, K. W.**
Crystal growth experiments on Russian unmanned spacecraft
[IAF PAPER 92-0934] p 151 A92-57307
- BENZI, R.**
A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
- BENZI, ROBERTO**
Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
- BERCHTOLD, G.**
Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472] p 87 N92-29650
- BERG, M.**
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP p 219 N92-14420
- BERGAMASCHI, SILVIO**
Equilibrium configurations in a tethered atmospheric mission
[AAS PAPER 91-543] p 124 A92-43391
- BERGELES, G. C.**
Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study p 178 A92-45603
- BERGEMANN, FRANK**
Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770
- BERGLIND, TORSTEN**
Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
- BERGMAN, C. M.**
A multiblock flow solver for inviscid hypersonic flows p 34 A92-14986
- BERGMANN, A.**
Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- BERLIN, CLAES**
Implementation of the total quality management concept within space business p 275 N92-18640
- BERNARD, DENYS**
A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- BERNE, C.**
Use of relative humidity sensors for planes measurement p 89 A92-32080
- BERNI, R.**
Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 N92-20611
- BERNIER, PAUL**
The ASPM program p 3 A92-41823
- BERNUSSOU, JACQUES**
Hermes-space station planning strategies optimization
[IAF PAPER 91-345] p 130 A92-14751
- BERRINO, UMBERTO**
FLOVIS (Flow Visualizer) user manual, release 2.6, September 1990 p 190 N92-16238
- BERRY, BERNARD F.**
Noise from military airfields in the United Kingdom p 226 A92-39052
- BERRY, W.**
Aerothermodynamic challenges for ESA programmes p 34 A92-14974
Grid impact on 3D hypersonic flows p 39 N92-15041
- BERTHELOT, D.**
The Hermes search and rescue operations in the open sea
[AIAA PAPER 91-4099] p 128 A92-24357
- BERTHOUMIEUX, P.**
Application of infrared thermography to thermal flux measurement in wind tunnels
[AAAF-NT-89-12] p 112 N92-11020
- BERTIN, D.**
A new automatic grid generation environment for CFD applications
[AIAA PAPER 92-2720] p 21 A92-45558
- BERTOGLIO, J. P.**
Experimental and theoretical investigation of a homogeneous turbulent shear flow
[ONERA, TP NO. 1992-43] p 180 A92-48604
- BERTOGLIO, JEAN-PIERRE**
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications
[ETN-92-90867] p 192 N92-19349
- BERTUZZI, S.**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- BES, CH.**
Structural optimization at Aerospatiale Aircraft
[AIAA PAPER 92-2371] p 256 A92-34542
- BESNARD, D.**
A spectral model for turbulent transport p 178 A92-45095

- BESSER, H.-L.**
High energy propulsion units for the year 2000
[ETN-92-90989] p 129 N92-20249
- BESSET, S.**
Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471
- BETHKE, KARL-HEINZ**
Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 N92-29877
- BETTSCHEART, N.**
Experimental and theoretical studies on helicopter rotor fuselage interaction
[ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction
[ONERA, TP NO. 1991-198] p 13 A92-26357
- BEYER, RALF**
ATTAS experimental cockpit and ATMOS for flight control components and systems investigations p 65 N92-25595
- BEYLICH, ALFRED E.**
Rarefied gas dynamics; Proceedings of the 17th International Symposium, Rheinisch-Westfaelische Technische Hochschule Aachen, Germany, July 8-14, 1990
[ISBN 1-56081-122-6] p 274 A92-52701
- BEZARD, H.**
Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations
[ONERA, TP NO. 1991-187] p 10 A92-16141
- BEZDENEZHNYKH, N. A.**
A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- BEZIAK, G.**
Organization and technical status of the NH90 European helicopter programme p 4 A92-56306
- BHATTI, R. S.**
A heat switch for space cryocooler applications p 160 N92-25852
- BHINDER, F. S.**
A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines
[ASME PAPER 91-GT-392] p 162 A92-15722
- BIANCHI, A.**
Innovation in the laser warning sensor field p 89 A92-35742
- BIDOKHTI, A. A.**
The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
- BIKKER, S.**
Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479
- BILANGE, THIERRY**
EUROFAR airframe aerodynamic design p 70 A92-35750
- BILLDAL, J. T.**
Spin-up in a semicircular cylinder p 184 A92-56123
- BILLONNET, GILLES**
Supersonic stator-rotor interaction in a turbine stage
[ONERA, TP NO. 1991-166] p 10 A92-16133
- BIRAUD, FRANCOIS**
SETI in France
[IAF PAPER 92-1023] p 282 A92-57345
- BIRCH, J. R.**
The near millimetre wavelength optical constants of calcium lanthanum sulphide p 272 A92-52965
- BIRCH, K. G.**
Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43
[IOS-288-1991] p 243 N92-29213
- BIRCH, N.**
The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- BIRCH, N. T.**
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
- BIRDSALL, DAVID L.**
Aircraft performance
[ISBN 0-521-36264-4] p 69 A92-33919
- BIRK, M.**
Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
- BISHOP, CRAIG H.**
The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
- BISSINGER, N. C.**
CFD contributions during hypersonic airplane intake design p 199 N92-27472
- CFD contributions during hypersonic airplane intake design
[MBB/FE213/S/PUB/459] p 50 N92-30676
- BLAISE, A.**
Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197
- BLANC, PHILIPPE**
Flow of fresh and salt water in an aquifer with injection from the top
[REPT-91-68] p 203 N92-30453
- BLANCHARD, A.**
The design and testing of an airfoil with hybrid laminar flow control
[ONERA, TP NO. 1992-22] p 24 A92-48585
- BLEEKER, O. F.**
An aircraft manufacturer's perspective p 2 A92-33430
- BLENNERHASSETT, P.**
Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228
- BLEULER, H.**
Control concepts for active magnetic bearings p 214 N92-27743
- BLOM, ANDERS F.**
Fatigue and damage tolerance verification of aircraft structures p 217 A92-19677
Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991
[FFA-TN-1991-24] p 219 N92-12313
- BLOW, CHRISTOPHER J.**
Airport terminals p 110 A92-21125
- BLOY, A. W.**
The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
- BLUME, H. T.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer
[IAF PAPER 91-105] p 119 A92-12508
- BLYTH, GRAHAM**
Parallel algorithms for panel methods p 165 A92-22346
- BOBER, RYSZARD**
Error analysis of the COSPAS SARSAT system p 129 A92-21288
- BOECKING, KLAUS F.**
Airborne experimental FLIR program p 93 N92-32447
- BOEHM, H.-D. V.**
Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
- BOEHNHARDT, HERMANN**
Photographic observations of the co-located spacecraft at 19 deg West p 138 N92-24724
- BOELCS, A.**
Quasi-three-dimensional characteristics method for a supersonic compressor rotor
[ASME PAPER 91-GT-81] p 7 A92-15549
- BOER, J. N.**
The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
- BOER, MICHEL**
The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft
[MPE-PREPRINT-175] p 283 N92-27049
- BOERRIGTER, H. L.**
Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321
- BOERSTOEL, J. W.**
An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations p 256 A92-45492
[AIAA PAPER 92-2619] p 23 A92-47079
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 259 N92-24411
Development and validation of a characteristic boundary condition for a cell-centered Euler method
[NLR-TP-90144-U] p 47 N92-28692
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations
[NLR-TP-91046-U] p 51 N92-32730
The 3-D Euler flows around modern airplanes
[PB92-138759] p 52 N92-70540
- BOESSWETTER, C.**
Recommended system concept p 224 N92-23383
Sensor compatibility/optimal sensor combinations p 224 N92-23403
National user interfaces p 224 N92-23407
- BOETSCH, R.**
Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
- BOETTCHER, JAN**
Jet aircraft noise at high subsonic flight Mach numbers
[DLR-FB-91-28] p 270 N92-29997
- BOETTCHER, ROLF-D.**
Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032
- BOFFADOSSI, M.**
Numerical simulation of unsteady rotor wakes p 27 A92-56352
Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
- BOGANI, LAURA**
Communicate space: A comparison of two case histories - Europe and USA
[IAF PAPER 92-0502] p 121 A92-55827
- BOGUS, K.**
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- BOHL, J. C.**
Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring
[AAAF-NT-89-28] p 185 N92-11288
- BOHLE, D.**
System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624
- BOKSENBERG, A.**
Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- BOLMS, H. T.**
Conception of a UHB engine simulator for the essential characteristics of a true-scale engine p 112 A92-54322
- BOMAN, PER-OLOF**
Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
- BOMBLED, JEAN-PIERRE**
Oriflamme - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles
[IAF PAPER 91-207] p 126 A92-14705
Ground operations of a HTOL airbreathing launcher
[IAF PAPER 91-217] p 125 A92-14708
- BOMMELAER, G.**
Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds p 53 A92-23302
- BONAZZOLA, SILVANO**
A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432
- BOND, N. R.**
Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484
- BONDIU, A.**
Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080
- BONIFACE, J. C.**
Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method
[ONERA, TP NO. 1991-177] p 10 A92-16139
- BONNEE, W. J. A.**
Examination of aircraft warning and caution lights after shock testing
[NLR-TP-89284-U] p 58 N92-30474
- BONNET, C.**
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
- BONNET, J. P.**
Compressibility effects in turbulent far wakes p 18 A92-40140
- BONNET, M.**
Modelling compressible turbulent mixing p 178 A92-45094
- BONNY, PHILIPPE**
Atmospheric transmission of polar meteorites
[ONERA-NT-1991-5] p 284 N92-20477
- BONON, FABRIZIO**
Equilibrium configurations in a tethered atmospheric mission
[AAS PAPER 91-543] p 124 A92-43391
- BONZANI, IDA**
Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724

- BOOTH, EARL R., JR.**
BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- BORCHARDT, H.**
Trial of a slant visual range measuring device p 210 N92-31043
- BORCHERS, INGO U.**
Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- BORCZ, RICHARD**
The need for active software product assurance management for systems critical software p 257 N92-18623
- BORGER, J.**
A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
- BORGHI, G.**
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
- BORGHI, R.**
Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- BORGONOV, CLAUDIO**
Communicate space: A comparison of two case histories - Europe and USA [IAF PAPER 92-0502] p 121 A92-55827
- BORILLO, M.**
Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764
- BORILLO, MARIO**
A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- BORREL, M.**
Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations [ONERA, TP NO. 1991-131] p 9 A92-16107
Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes [ONERA, TP NO. 1991-237] p 13 A92-26387
Navier-Stokes computation over a three-dimensional ramp [ONERA, TP NO. 1992-55] p 181 A92-48616
- BORRELLI, SALVATORE**
High enthalpy nozzle flows p 36 N92-15000
Influence of chemical modelling on hypersonic flow p 37 N92-15015
- BORRIELLO, G.**
CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 N92-14980
- BORSI, M.**
Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 N92-12998
Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- BORTHWICK, A. G. L.**
Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511
- BOSCHER, D.**
Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020
Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003
- BOSCHER, D. M.**
Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450
Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
- BOTHE, HELMUT**
The basic measuring technical equipment of the DLR test aircraft p 92 N92-25592
Introduction and execution of flight tests at the DLR p 85 N92-25594
- BOTTARO, ALESSANDRO**
Transition to turbulence in curved channel flow p 18 A92-40125
- BOUCHIE, Y.**
CARS temperature measurements and validation of a computing code on a gas-turbine combustor [ONERA, TP NO. 1991-224] p 94 A92-26376
- BOUDIER, P.**
The coherent flamelet model for propulsion applications p 147 N92-27486
- BOUDINET, P.**
Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
- BOUIX, J.**
Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292
- BOULAY, JEAN-LOUIS**
Aircraft lightning strikes [ONERA, TP NO. 1991-204] p 54 A92-26361
- BOURAS, B.**
Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- BOURDAIS, E.**
Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- BOURGALT, Y.**
Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
- BOURGOIS, G.**
Multidimensional upwind methods for unstructured grids p 201 N92-27675
- BOURRIEAU, J.**
LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231
- BOUSMAN, WILLIAM G.**
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
- BOUSQUET, J. M.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
- BOUVET, J.**
Sodar wind speed profiles over forested boundary layer during the Hapex-Mobilhy campaign p 235 A92-17729
- BOYD-LEE, A. D.**
Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
- BOYSAN, H. F.**
Internal flow modelling of vortex throttles p 168 A92-27385
- BRABY, CAROLE D.**
The development of a working model of flight crew underload p 249 A92-13019
- BRACHET, M. E.**
Direct simulation of three-dimensional turbulence in the Taylor-Green vortex p 162 A92-15483
- BRADLEY, JOHN**
Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system p 71 A92-35937
- BRADLEY, R.**
The use of inverse simulation for conceptual design p 70 A92-35738
- BRADSHAW, P.**
Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055
- BRAEUNLING, W.**
Conception of a UHB engine simulator for the essential characteristics of a true-scale engine p 112 A92-54322
- BRAMA, TORSTEN**
The structural optimization system OPTSYS: Current status and applications p 83 N92-23232
- BRAMSKI, STEFAN**
Selected models of aircraft navigation space p 61 A92-45373
- BRAMSON, B. D.**
The avoidance of collisions for Newtonian bodies with hidden variables p 59 A92-24945
- BRANDECKER, B.**
Methodology for assessment of skin repairs on Airbus aircraft p 219 N92-14428
Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- BRANDSMA, F. J.**
System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
- BRANDT, E. H.**
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors p 273 N92-21635
- BRANDT, MADS H.**
The SAS Flight Analysis and Aircraft Monitoring System p 89 A92-35941
- BRANDT, RUNE**
Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 N92-22209
- BRANGIER, FRANCIS**
The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system p 58 A92-13851
Monopulse secondary surveillance radar and the mode-S surveillance system p 62 A92-53239
- BRAS, M.**
Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764
- BRAUERS, JOSEF**
Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691
- BRAY, D.**
Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446
Impinging jets in cross-flow p 169 A92-28942
Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549
- BRAYBROOK, ROY**
Rapidly going nowhere? p 74 A92-54545
- BRAZA, M.**
Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- BRAZIER, J. PH.**
Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
- BRAZZALE, P.**
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
- BREBBIA, C. A.**
Computational methods in viscous aerodynamics p 11 A92-21976
- BREITMAYER, JEAN-PHILIPPE**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- BREKKE, A.**
The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
- BREMER, M. N.**
Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- BRENNEIS, A.**
Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- BRENNER, G.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
- BRESCIANI, D.**
Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315
- BRETTAUER, BERNWARD**
Development of an electronic high speed camera system for the quantitative analysis of unsteady flows [MPIS-100/1991] p 209 N92-17344
- BREVIK, I.**
Velocity correlation in isotropic turbulence according to a modified Obukhov theory p 169 A92-28950
- BRIANE, M.**
G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
- BRIERLEY, C. J.**
The near millimetre wavelength optical constants of calcium lanthanum sulphide p 272 A92-52965
- BRISCOLINI, M.**
A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
- BRISON, CORINNE**
Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- BROADBENT, E. G.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- BROATCH, S. A.**
An integrated navigation system manager using federated Kalman filtering p 90 A92-48477
- BROECKER, W.**
Fatigue life behaviour of composite structures p 145 N92-18577
- BROGNIEZ, G.**
A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771
- BROOKS, A. J.**
An Axial Turbobrake [ASME PAPER 91-GT-1] p 211 A92-15501

- BROOKS, THOMAS F.**
BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- BROUSSAUD, P.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- BROUWER, M.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- BROUWER, W.**
Real-time helicopter simulation using the blade element method p 264 A92-56278
- BROWELL, E. V.**
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 A92-29304
- BROWN, D. L.**
LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468
- BROWN, M. J.**
The e-beam sustained laser technology for space-based Doppler wind lidar p 240 A92-52300
- BROWN, PHILIP R. A.**
In situ measurements of the ice water content in cirrus clouds p 236 A92-22952
- BRUEHL, STEPHAN**
The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 A92-15938
- BRUN, RAYMOND**
Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739
- BRUN, V. J.**
Thermomechanical model of the linkage between an I.R. window and the housing device [ONERA, TP NO. 1991-158] p 131 A92-16126
- BRUNAMONTI, M.**
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 A92-24474
- BRUNEAU, D.**
Single alexandrite laser source for airborne DIAL system p 210 A92-51228
- BRUNESSAUX, S.**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- BRUNET, YVES**
Using the radiative surface temperature in energy budget studies over plant canopies p 223 A92-11506
- BRUNO, C.**
Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
- BRUSCHERA, D.**
Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 A92-19926
- BRUSTET, JEAN M.**
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- BRY, PIERRE-FRANCOIS**
Recent progress in inverse methods in France p 97 A92-13938
- BRYANSTON-CROSS, P. J.**
A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
- BRYCE, S. G.**
Flow structure and mixing in obstructed and confined jets p 174 A92-40107
- BUCCI, A.**
CFRP stiffened panels under compression p 146 A92-33044
- BUCHHOLZ, JOERG J.**
Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 A92-29870
- BUCK, C.**
Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
- BUCKLOW, I. A.**
Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
- BUECKER, H.**
Long-term exposure of bacterial spores to space p 244 A92-27126
- BULTJES, P. J. H.**
The main lines of the research programs remote sensing: Climate and environment [BCRS-91-25] p 230 A92-29499
- BULL, G. V.**
Base bleed technology in perspective p 17 A92-39427
- BUNKOV, Y. M.**
Vortex nucleation in rotating superfluid He-3-B p 271 A92-10476
- BUONGIORNO, CARLO**
Space activities in Italy p 121 A92-53457
- BUR, REYNALD**
Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 A92-19932
- BURGE, S.**
The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- BURGS Mueller, W.**
Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
- BURIEZ, J. C.**
A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771
- BURKE, W. R.**
Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 A92-23780
Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 A92-24432
- BURROWS, ANDREW P.**
The flow past bluff bodies by a vortex method [AERO-REPT-9016] p 191 A92-18291
- BURROWS, S. P.**
Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908
- BURTON, C. D.**
Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
- BUSS, STEPHEN L.**
A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988 [AD-A246775] p 243 A92-28365
- BUTHION, C.**
Benefits of electric propulsion for orbit injection of communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709
- BUTLER, C. F.**
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 A92-29304
- BUTLER, G. C.**
Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547
- BUXBAUM, O.**
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 A92-14397

C

- CABON, PH.**
Vigilance of aircrews during long-haul flights p 247 A92-45021
- CABON, PHILIPPE**
Vigilance in transport operations - Field studies in air transport and railways p 249 A92-11173
- CABOT, WILLIAM H.**
A dynamic subgrid-scale eddy viscosity model p 203 A92-30649
A subgrid-scale model based on the second-order velocity structure function p 203 A92-30651
- CAIN, T. M.**
A comparison of numerical predictions and experiments on under-expanded jets [AIAA PAPER 92-4027] p 141 A92-56849
- CALVERT, W. J.**
Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 A92-27452
- CAMBIER, LAURENT**
Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 A92-27462
- CAMERINO, P.**
RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 A92-18647
- CAMPAN, G.**
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
- CAMPBELL, J. F.**
Vortex flow aerodynamics [AGARD-AR-299] p 50 A92-30947
- CANARD-CARUANA, S.**
Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363
Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169
Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) [ONERA-RT-16/3641-PY] p 269 A92-20387
- CANDEL, S.**
Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
The coherent flamelet model for propulsion applications p 147 A92-27486
- CANDEL, T. M.**
Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- CANDLER, L. W.**
High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
- CANET, J. MIQUEL**
Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 A92-14990
- CANOT, E.**
An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
- CANT, C. G.**
Impact of regulation changes on engine design and certification [PNR-90789] p 99 A92-22098
- CAPDEVIELLE, M. C.**
Management of navigation means failure in Hermes space vehicle p 136 A92-24467
- CAPELLI, C.**
Blood lactate during leg exercise in microgravity p 247 A92-50162
- CAPINSKI, MAREK**
A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256
- CAPODANNO, P.**
Some problems of the stability of a system of three vortices p 182 A92-51893
- CAPORICCI, L.**
Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 A92-24443
- CAPUANO, A.**
Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980
- CARADONNA, F. X.**
Experimental and computational studies of hovering rotor flows p 22 A92-46954
The computation and validation of hovering rotor performance p 74 A92-56285
- CARAMASCHI, VITTORIO**
The Eurofar vehicle overview p 67 A92-14416
- CARBONARO, MARIO**
Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment p 56 A92-21697
- CARDONE, G.**
Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
- CAREL, OLIVIER**
The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service p 59 A92-13852
- CARESSA, J. P.**
Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 A92-14995
- CARETTE, E.**
Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- CARIOU, JEAN-PIERRE**
Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 A92-31059
- CARLOMAGNO, G. M.**
Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002

- CARLQVIST, STIG G.**
Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779
- CARLSSON, INGEMAR**
Aerospace software in Sweden p 255 A92-19406
- CARON, P.**
Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
- CARRILLO, RENE**
Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
- CARROU, J. P.**
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
- CARSTENS, V.**
Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
- CARTER, A. F.**
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- CARTER, PHILIP**
On the approximate representation of velocity and shear stress distributions in low-speed boundary layers [AERO-REPT-9012] p 192 N92-18319
- CASALIS, G.**
The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code [CERT-RT-63/5618-54] p 185 N92-11306
- CASCIOLA, C.**
A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
- CASCIOLA, C. M.**
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
- CASSAING, J. J.**
Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004
- CASTOLDI, P.**
AM-X flight simulator from engineering tool to training device p 116 N92-28536
- CASTRO, I. P.**
Three-dimensional separated flows p 173 A92-40088
Computations of a separated turbulent boundary layer p 174 A92-40131
- CATALLO, CLAUDIO**
Italsat spacecraft multibeam payload antenna closed loop fine pointing system [IAF PAPER 91-509] p 129 A92-18519
- CATENA, V.**
High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- CATTANEO, GILBERT**
Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683
- CAUDAL, GERARD**
Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- CAUMES, PHILIPPE**
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- CAUSSIGNAC, P.**
Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
- CAVALLO, ALBERTO**
Robust flight control systems - A parameter space design p 106 A92-50503
- CAVES, ROBERT**
A review of UK aviation policy [TT-9107] p 5 N92-12988
- CAYZAC, R.**
Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- CAZALA-HOURCADE, ERIC**
Apogee manoeuvre strategies for the Inmarsat-2 spacecraft [AAS PAPER 91-364] p 123 A92-43262
- CAZALBOU, J. B.**
Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765
- CAZENEUVE, H.**
Single alexandrite laser source for airborne DIAL system p 210 A92-51228
- CAZES, R. J.**
Aircraft tracking optimization of parameters selection p 79 N92-18585
- CENEDESE, A.**
Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
- CERBE, T. M.**
Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302
- CERCIGNANI, CARLO**
The Harold Grad Lecture - Mathematics and the Boltzmann equation p 274 A92-52702
- CERNOGORA, G.**
Rotational temperature measurements in an arc jet p 177 A92-44395
Rotational temperature measurements of N₂(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982
- CHADOURNE, S.**
The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666
- CHAMBERS, A. R.**
Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- CHAMPA, JOHN**
Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
- CHAMPETIER, C.**
Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- CHAMPIGNY, P.**
Vortex flow on a missile body: Experimental study and modeling p 32 N92-13013
- CHANA, K. S.**
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 N92-14319
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466
- CHANETZ, B.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- CHAPIN, V.**
Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- CHAPKOV, S. K.**
A method for determining the potential of a spacecraft p 131 A92-23433
- CHARLES, D.**
Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- CHARLES, JEAN**
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
- CHARON, P.**
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630
- CHARPILLET, F.**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- CHARRON, J.**
Criticality management in space programs p 275 N92-18619
- CHARRON, P.**
Reliability, availability, maintainability, and safety p 216 N92-18639
- CHASSAING, P.**
Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765
- CHATRENET, D.**
Flight simulation and digital flight controls p 115 N92-28526
- HATZITHEODORIS, E.**
Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284
- CHAUVAT, PHILIPPE**
Transport coefficients in discrete kinetic theory and comparison with classical fluid dynamics p 274 A92-52782
- CHAVIARPOPOULOS, P.**
Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- CHAVY, S.**
Design of penetration-oriented MARV [AIAA PAPER 92-1003] p 127 A92-33195
- CHEDIN, A.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- CHEMOUL, B.**
Dynamic load cases on Ariane 5 p 127 N92-23797
- CHEN, D.**
Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045
- CHEN, QING**
Some important factors in turbulence in flight measurement p 90 A92-54324
- CHENARD, STEPHANE**
Twilight of the machine builders p 279 A92-20515
Insurance turns the corner p 278 A92-20516
- CHENG, BIN**
'Space objects', 'astronauts', and related expressions p 281 A92-51854
- CHEVREL, M.**
The French space program for earth observation p 222 A92-37154
- CHEVRIER, NOEL**
Human factors and simulation p 55 A92-53236
- CHEW, N. G.**
High temperature superconducting vortex flow transistor p 159 A92-38971
- CHILDS, P. N.**
The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090
- CHISNALL, G.**
British Aerospace Hawk into the 1990s p 73 A92-50009
- CHMIELNIAK, TADEUSZ**
Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
- CHOLLET, J. P.**
Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
- CHPOUN, A.**
Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
Compression ramp in rarefied gas [RC-90-08] p 29 N92-11978
Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 N92-11979
Flat plates placed in depleted hypersonic flow [SESSIA-430/91-960] p 50 N92-31508
- CHRISTIE, P. I.**
Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548
- CHRISTOPHE, B.**
Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
- CHRISTOPHERSON, TOM**
Eurocontrol - UK detention rights p 280 A92-33048
- CHU, Q. P.**
Modelling and identification of flexible spacecraft p 131 A92-15409
- CHUN, CH.-H.**
Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
- CISLAGHI, M.**
SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859
- CLARK, J. P.**
Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118
- CLARK, PHILLIP S.**
Australian space - Looking for a direction p 120 A92-36073
- CLARKE, J. F.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- CLAUD, C.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- CLAUDET, G.**
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875

- CLAUSSET, F.**
Vectorising the smooth particle hydrodynamics
p 161 A92-10037
- CLEAK, J. G. E.**
Turbulence modelling for secondary flow prediction in a turbine cascade
[ASME PAPER 91-GT-57] p 7 A92-15535
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade
p 198 N92-27457
- CLERE, JEAN-MICHEL**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes
p 252 N92-18994
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies
p 252 N92-18996
- CLOUGH, SID A.**
Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87
p 235 A92-18902
- CLUMPCKENS, RENE W.**
The role of the notary under the laws of the Netherlands - With respect to the transfer of title and encumbrance of registered aircraft
p 280 A92-35595
- COATES, A. J.**
The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415
- COBLENTZ, A.**
Vigilance of aircrews during long-haul flights
p 247 A92-45021
- COBLENTZ, ALEX M.**
Vigilance in transport operations - Field studies in air transport and railways
p 249 A92-11173
- COCHER, G.**
Use of relative humidity sensors for planes measurement
p 89 A92-32080
- COEL, V.**
Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080
- COELHO, P. J.**
Validation of non-orthogonal three-dimensional laminar flow predictions
p 199 N92-27476
- COET, M.-C.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels
[ONERA, TP NO. 1992-39] p 111 A92-48600
- COGOLI, AUGUSTO**
Changes observed in lymphocyte behavior during gravitational unloading
p 247 A92-52395
- COHEN-ZARDY, D.**
Circulatory biomechanics effects of accelerations
p 248 N92-18991
- COIFFIER, B.**
Structural optimization of aircraft practice and trends
p 83 N92-23239
- COIRO, D. P.**
Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method
p 18 A92-40600
- COKER, A. J.**
The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415
- COLANTUONI, S.**
Numerical computations of transonic flows through cascades
[AIAA PAPER 92-3041] p 24 A92-48702
- COLASSON, M.**
Concept for a European Space Station: Habitability, life support, and laboratory facilities
p 254 N92-27023
- COLASURDO, GUIDO**
Optimal finite-thrust spacecraft trajectories
[AIAA PAPER 92-4510] p 124 A92-52080
- COLELLA, M.**
A simple point vortex model for two-dimensional decaying turbulence
p 171 A92-36192
- COLLARD, DUDLEY**
Supersonic transport in the 21st century
p 2 A92-26793
- COLLERCANDY, RANJIT**
An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations
[AIAA PAPER 92-2613] p 20 A92-45487
- COLLIN, G.**
CARS temperature measurements and validation of a computing code on a gas-turbine combustor
[ONERA, TP NO. 1991-224] p 94 A92-26376
- COLLOREC, LUC**
Pressure field developed by the random movement of the vortices near a wall
[ETN-92-91665] p 204 N92-32770
- COLUCCI, FRANK**
Hypersonic materials
p 143 A92-18002
- COMBES, F.**
Vectorising the smooth particle hydrodynamics
p 161 A92-10037
- COMTE, P.**
Numerical simulation of transition to turbulence in free-shear layers
p 167 A92-26221
A subgrid-scale model based on the second-order velocity structure function
p 203 N92-30651
- CONCILIO, A.**
Active vibrations and noise control for turboprop application research program activities
p 271 N92-32962
- CONDOMINES, A.**
Towards an electronic dictionary of the space technical domain
[IAF PAPER 92-0354] p 277 A92-55764
- CONNOLLY, C. F.**
Use of CFD in the design of a modern multistage aero engine LP turbine design
[PNR-90862] p 98 N92-20179
- COOKE, R.**
Why quantify risk?
p 153 N92-18637
- COOPER, IAIN M.**
The role of diffusive effects on potential vorticity in fronts
p 238 A92-51781
- COOPER, J. E.**
Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures
p 131 A92-15410
Spacecraft in-orbit identification using eigensystem realization methods
p 132 A92-28133
Model parameter identification techniques for flight flutter testing
[AERO-REPT-9105] p 107 N92-18294
- COQUEL, F.**
Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies
p 188 N92-15029
- CORNUAULT, C.**
Structural optimization of aircraft practice and trends
p 83 N92-23239
Structural optimization of aircraft
p 86 N92-28472
- CORTES, V.**
Application of eddy current techniques to graphite composite materials
[ETN-92-90815] p 145 N92-21416
- COSTA, JORGE**
Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum
p 196 N92-24343
- COSTAMAGNA, LAZZARO**
A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design
p 139 N92-25881
- COSTES, M.**
Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors
[ONERA, TP NO. 1991-178] p 10 A92-16140
- COSTES, P.**
Integration of flight and carrier landing aid systems for shipboard operations
p 64 N92-21958
- COUAILLIER, V.**
Validation of a 3D Navier-Stokes code on experimental compressor bladings
[ONERA, TP NO. 1991-229] p 13 A92-26381
- COUDERT, J. F.**
Diagnostics of thermal spraying plasma jets
p 213 A92-55403
- COULTON, DAVID G.**
Recent developments in data acquisition and control systems at the Aircraft Research Association Limited
p 112 A92-54323
- COUPEZ, DOMINIQUE**
Computer codes for ballistic performance calculations of base bleed propellant grain
p 17 A92-39433
- COUPLAND, JOHN**
Practical application of 3-D CFD methods to gas turbine combustors
[PNR-90773] p 194 N92-21742
- COURBET, B.**
Study of a class of two-point box schemes with application to one-dimensional fluid dynamics
p 170 A92-29998
- COUSTEIX, J.**
Asymptotic defect boundary-layer theory applied to hypersonic flows
p 15 A92-36839
Influence of suction through a slot on a turbulent boundary layer
p 18 A92-40127
Characteristics of a boundary layer in a leading edge vortex
p 31 N92-13012
- COUSTEIX, JEAN**
Basic concepts on boundary layers
p 44 N92-27707
- COUSTOLS, E.**
Turbulent skin-friction drag reduction by active and passive means, part 1
p 44 N92-27714
- COUZI, J.**
Determination of the aerodynamic flow about a reentry body at high altitude
p 14 A92-28975
- COX, J. C.**
Use of CFD in the design of a modern multistage aero engine LP turbine design
[PNR-90862] p 98 N92-20179
- COX, M. E.**
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions
[NLR-TP-91062-U-PT-1] p 66 N92-29605
- CRABB, R. L.**
Power system performance prediction for the Hipparcos spacecraft
p 141 N92-13155
- CRAFT, T. J.**
Computation of impinging flows using second-moment closures
p 173 A92-40083
- CRAIG, K. H.**
Reduction of target scattering by tropospheric modification
p 157 N92-19164
- CRANE, R. I.**
Boundary layers and transition on concave surfaces
p 196 N92-24341
- CRANS, BEREND J. H.**
Selected pitfalls and booby-traps in aircraft finance
p 280 A92-35587
- CRETENET, J. C.**
A research and technology program for the benefit of the Ariane family
[IAF PAPER 92-0873] p 127 A92-57262
- CRIGHTON, D. G.**
The jet edge-tone feedback cycle - Linear theory for the operating stages
p 167 A92-24758
- CRIGHTON, DAVID G.**
Airframe noise
p 268 N92-10605
- CRIVELLI VISCONTI, I.**
Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings
p 144 A92-42141
- CROFT, ROGER J.**
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system
p 253 N92-19013
- CROWTHER, R.**
Re-entry aerodynamics derived from space debris trajectory analysis
p 123 A92-41764
Debris reentry prediction: Salyut-7/Kosmos-1686
p 125 N92-23973
Limitation of space debris in geostationary transfer orbit
p 125 N92-24774
- CRUMPTON, P. I.**
Cell vertex finite volume discretizations in three dimensions
p 168 A92-27475
- CUENCA, P. V.**
Fuzzy guidance system evaluation
p 259 N92-27903
- CULJKOVIC, M.**
Reliability, availability, maintainability, and safety
p 216 N92-18639
- CULJKOVIC, MIODRAG**
Constraints and difficulties in implementations of RAMS assurance programmes
[MBB-UK-0141-91-PUB] p 215 N92-17544
- CUMMINGS, M.**
Dynamic solder management
[AD-A250564] p 150 N92-29647
- CUNNINGHAM, A. M., JR.**
Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft
p 108 N92-27958
Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program
[PB92-138676] p 53 N92-70590
- CUNNINGHAM, ATLEE M., JR.**
Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft
[AIAA PAPER 92-4501] p 27 A92-55369
- CURDT-CHRISTIANSEN, CLAUS**
EEG as screening method in aeromedical selection of air crew
p 246 A92-16408
- CURTIS, P.**
Impinging jets in cross-flow
p 169 A92-28942
- CUTLAND, NIGEL**
A simple proof of existence of weak and statistical solutions of Navier-Stokes equations
p 166 A92-23256

D

- D'AMORE, M.**
An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- D'ANGELO, L.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
Columbus user support organization concept in Italy p 119 A92-32465
An economic benefit deriving from space activities - Integration between science institutions and industry [IAF PAPER 92-0177] p 279 A92-55635
- D'ESPINEY, P.**
Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations [ONERA, TP NO. 1991-131] p 9 A92-16107
- D'HUMIERES, C.**
Aerosol behavior in supersonic flows [ONERA, TP NO. 1991-155] p 206 A92-16124
- DACHEV, TS. P.**
A method for determining the potential of a spacecraft p 131 A92-23433
- DACOSTA, J. L.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 A92-14977
Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 A92-15025
- DAGENS, L.**
Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
- DAHL, O.**
An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
- DAILEY, G. M.**
Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 A92-20179
- DALLEY, S.**
Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
- DALLMANN, UWE**
On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 A92-13005
- DALTON, FRANK**
Aviation meteorology p 237 A92-38383
- DALY, E. J.**
Power system performance prediction for the Hipparcos spacecraft p 141 A92-13155
- DALY, KIERAN**
The real TCAS p 54 A92-25521
- DAMBRINK, J. H. A.**
Control of blood pressure in humans under microgravity p 248 A92-23071
- DAMS, R. A. J.**
Air purification systems for submarines and their relevance to spacecraft p 253 A92-25892
Critical technologies: Spacecraft habitability, an update p 254 A92-27010
- DANDO, ANDREW**
The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441
- DANIEL, E.**
A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899
- DANKERT, CARL**
Near-field expansion in thruster plumes p 141 A92-52799
- DAU, K.**
Computation of viscous phenomena in unsteady transonic flow p 46 A92-27949
- DAUM, ALF**
Solving the aeroassisted orbital transfer problem by using a sequential optimization approach [AIAA PAPER 92-4646] p 124 A92-55401
- DAUMAS, T.**
Circulatory biomechanics effects of accelerations p 248 A92-18991
- DAURIA, RENATO**
A combined cabin/avionics air loop design for the Space Station logistic module p 253 A92-25841
- DAVID, C.**
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 A92-29306
- DAVID, M.**
Spherically symmetric, polytropic flow p 284 A92-20810
- DAVID, TIM**
Parallel algorithms for panel methods p 165 A92-22346
- DAVID, VALERIE**
Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 A92-23750
- DAVIDOV, D. D.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- DAVIDSON, LARS**
Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803
- DAVIES, D. M.**
The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257
- DAVINSON, IAN**
The use of optical sensors and signal processing gas turbine engines p 90 A92-46247
- DAVIS, R.**
Advanced tactical fighter engine [ETN-92-90840] p 97 A92-18728
- DAVIS, R. I.**
Integrating machine intelligence into the cockpit to aid the pilot p 252 A92-12533
- DAVIS, ROBERT E.**
Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173
- DAWES, W. N.**
The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology [ASME PAPER 91-GT-124] p 8 A92-15569
- DE BELLEVAL, J. F.**
Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- DE BIASE, L.**
An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- DE BILLY, M.**
Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- DE BONDELI, PATRICK**
Aerospace Software Engineering in France p 255 A92-19404
- DE BRUIN, H. A. R.**
The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345
- DE DIVITIIS, N.**
Fluid dynamic forces on tethered satellite systems p 124 A92-52738
- DE GOEJE, M. P.**
Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088
- DE LA VIUDA, JOSE M.**
Patch-independent structured multiblock grids for CFD computations p 263 A92-47078
- DE MARIA, GIUSEPPE**
Robust flight control systems - A parameter space design p 106 A92-50503
- DE MATTEIS, GUIDO**
Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
Hang-glider response to atmospheric inputs p 104 A92-46765
- DE MATTEIS, P.**
Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
- DE ROSA, S.**
Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
- DE SOCIO, L. M.**
Fluid dynamic forces on tethered satellite systems p 124 A92-52738
- DE SOCIO, LUCIANO M.**
Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
- DEBIEVE, J. F.**
A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
- DEBOER, A.**
Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 A92-28650
- DEBOER, E.**
VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 A92-18323
- DEBOER, W. P.**
Aircraft simulation and pilot proficiency: From surrogate flying towards effective training p 115 A92-28532
Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 A92-28652
- DEBOUT, BRUNO**
French research and technology program on advanced hypersonic propulsion [AIAA PAPER 91-5003] p 94 A92-31683
- DECONINCK, H.**
Multidimensional upwind methods for unstructured grids p 201 A92-27675
Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 A92-27678
A frontal approach for node generation in Delaunay triangulations p 201 A92-27680
- DECUYPERE, R.**
Study of a technique of low level turbulence detection [ETN-91-90107] p 186 A92-12215
- DEDIEU, J. P.**
AS 332 MKII - Development and certification p 75 A92-56343
- DEFOSSE, P.**
Aircraft tracking optimization of parameters selection p 79 A92-18585
- DEHAYE, V.**
Fatigue safety factor: Assessment of associated safety level p 220 A92-18573
- DEJONG, H.**
Development environment for digital manipulator simulators [PB91-222190] p 213 A92-16313
- DEJONGE, J. B.**
Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 A92-15065
Ageing aircraft research in the Netherlands p 57 A92-30129
Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989 [PB92-138650] p 88 A92-70591
- DEL CASTILLO CABRERIZO, LORENZO**
Iberia's Aeronautical Mapping Application (ACAI) p 60 A92-37073
- DELAHAIS, MAURICE**
European Space Agency - Achievements and perspectives p 121 A92-53459
- DELAYE, MICHEL**
European industrial capabilities to provide meteorological space systems p 228 A92-25238
- DELERY, JEAN**
Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
- DELERY, JEAN M.**
Separation and vortex formation in turbulent flows [ONERA, TP NO. 1992-7] p 24 A92-48579
- DELL'ERBA, M.**
An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- DELLIPRISCOLI, FRANCESCO**
Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 A92-30941
- DELOGU, A.**
Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 A92-19151
- DELOREME, PHILIPPE**
Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 A92-10988
- DELPECH, P.**
Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 A92-11020
- DELPORTE, M.**
Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- DELPY, P.**
Robust control of an aerodynamically unstable launcher with bending modes p 136 A92-24471
- DELRE, ENRICO**
Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 A92-30941
- DELRIEUX, Y.**
Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) [ONERA-RT-16/3641-PY] p 269 A92-20387

- DELUCA, L.**
Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 N92-15002
- DELVILLE, J.**
Compressibility effects in turbulent far wakes p 18 A92-40140
- DEMME, JOHANN**
The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349
The icing of the elevator of the DLR icing research aircraft of Do 28 type p 58 N92-31813
[DLR-MITT-91-12] p 58 N92-31813
Analysis of three icing test flights reaching the aircraft-referred icing degree of severe [ESA-TT-1254] p 58 N92-31943
- DEMOLLERAT, T.**
Reliability modeling for non-electronic systems p 216 N92-18633
- DEMONTLIVAU, J. L.**
Organisational robustness for manned space flight p 152 N92-18618
- DENBOER, R. G.**
Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program [PB92-138676] p 53 N92-70590
- DENBRAVEN, W.**
NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 N92-29204
- DENER, C.**
IGG - An interactive 3D surface modelling and grid generation system [AIAA PAPER 92-0073] p 256 A92-22186
An integrated CFD system for 3D turbomachinery applications p 101 N92-27464
- DENG, G. B.**
Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- DENNER, W.**
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- DENOIRJEAN, A.**
Diagnostics of thermal spraying plasma jets p 213 A92-55403
- DENTON, J. D.**
Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
An experiment on unsteady flow over an oscillating airfoil [ASME PAPER 91-GT-181] p 8 A92-15613
- DEOM, A.**
Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020
- DEOM, A. A.**
Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography p 206 A92-21450
Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003
Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004
- DEPOLT, TH.**
Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302
- DEPONTE, S.**
Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
- DERVIEUX, ALAIN**
Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157
- DERYCKE, ERIC**
The role of Belgium in Earth observation from space programs p 229 N92-25245
- DESAINTE-VICTOR, X.**
Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile [CERT-RT-65/5604-35] p 185 N92-11307
- DESARD, F.**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- DESNOYER, D.**
Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748

- Large thin composite thermostructural parts p 134 N92-23821
- DESOPPER, A.**
Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
- DESPLATS, E.**
Modern control techniques for spacecraft AOC/GNC systems p 237 N92-24495
- DESSE, J. M.**
Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction p 12 A92-24426
- DESSE, JEAN-MICHEL**
Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- DESTUYNDER, PHILIPPE**
A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- DESWAANARONS, HINDRIK**
Delfi: Design, development, and applicability of expert systems shells [ISBN-90-6275-734-0] p 259 N92-25306
- DETTLEFF, GEORG**
Near-field expansion in thruster plumes p 141 A92-52799
- DEUTSCH, E.**
Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
- DEUZE, J.-L.**
Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- DEVAUX, C.**
Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- DEVEZE, A. D.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
- DEWILDE, J. P.**
Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271
- DI CECCHA, A.**
The enhancement of the Italsat spacecraft - A step forward the communication satellites [IAF PAPER 91-473] p 131 A92-18494
- DI FELICE, F.**
Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
- DI GIROLAMO, S.**
Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
- DI MARTINO, P.**
Numerical computations of transonic flows through cascades [AIAA PAPER 92-3041] p 24 A92-48702
- DI MASCO, ANDREA**
A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
- DIBARTOLOMEO, W.**
Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- DICK, E.**
A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617
- DIET, JEAN**
Patch-independent structured multiblock grids for CFD computations p 263 A92-47078
- DIETL, LOTHAR**
Test and integration concept for complex helicopter avionic systems p 90 A92-56292
- DIETRICH, STEFAN**
Efficient computation of particle movement in 3-D DSMC calculations on structured body-fitted grids p 256 A92-52771
- DIETZ, ANTHONY JOHN**
Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- DIGENNARO, S.**
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
- DIGIACINTO, M.**
Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
- DILLIES, B.**
The coherent flamelet model for propulsion applications p 147 N92-27486

- DINDAR, MUSTAFA**
Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil [AIAA PAPER 92-0027] p 11 A92-22149
- DINE, C.**
Characterization of subcritical and supercritical jets by an acoustic imagery method [ONERA, TP NO. 1992-34] p 267 A92-48595
- DING, D.**
The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- DINH, Q. V.**
Status and user characterization of parallel machines for digital simulation p 260 A92-23046
- DMITRIEV, V. V.**
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788
- DO NASCIMENTO, MARCO A. R.**
The selective bleed variable cycle engine [ASME PAPER 91-GT-388] p 93 A92-15720
- DODDS, S. J.**
A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
- DODEL, H.**
Lite-Sat's for specific communication tasks p 156 N92-15232
- DODEMAND, E.**
Behavior of a suspension in the presence of a potential vortex [ONERA, TP NO. 1991-140] p 163 A92-16114
- DOHERR, KARL-FRIEDRICH**
Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155
- DOHMEN, H.-J.**
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234
- DOLD, JUERGEN**
A large format film camera for high precision object recording p 207 A92-51630
- DOLMAN, W. C.**
Software methodologies for safety critical systems p 257 N92-12467
- DONKER, J. C.**
A knowledge-based assistant for diagnosis in aircraft maintenance p 5 N92-12538
Reasoning with uncertain and incomplete information in aerospace applications p 261 N92-12544
Application of knowledge-based systems for diagnosis of aircraft systems [NLR-TP-90192-U] p 57 N92-28655
- DORE, B.**
An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- DOREY, GERARD**
Productivity and quality in the Modane and Fauga wind tunnels - Prospects for the 90s [ONERA, TP NO. 1991-203] p 111 A92-26360
- DORMIEUX, M.**
Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes [ONERA, TP NO. 1991-237] p 13 A92-26387
- DOURSAT, C.**
Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
- DOWNIE, M.**
Effect of viscous damping on the response of floating bodies p 187 N92-14303
- DRAPER, JONATHAN**
Formal verification of a redundancy management algorithm p 257 N92-12457
- DREXLER, JAN**
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
- DRIKAKIS, D.**
Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
- DRITSCHEL, DAVID G.**
The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
- DRIVER, D.**
Introduction to metal matrix composites and a review of their potential uses p 144 A92-45336
Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938

- DRUILHET, AIME**
Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAE-T campaign) - Variability of boundary conditions and eddy flux parameterization p 235 A92-14052
- DUBAND, L.**
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875
- DUBOIS, ISABELLE**
Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- DUBOIS, KITSOU**
Analogy between training for dancers and problems of adjustment to microgravity - An evaluation of the subjective vertical in dancers [IAF PAPER 90-653] p 245 A92-12125
- DUBOIS, M. A.**
Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- DUBROCA, B.**
Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- DUC, J. M. NGUYEN**
The turbomachine blading design using S2-S1 approach p 97 N92-13940
- DUCHON, JEAN**
Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
- DUDECK, M.**
Rotational temperature measurements in an arc jet p 177 A92-44395
Rotational temperature measurements of $N_2(+)$ in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982
- DUDEK, H.-L.**
Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- DUDLEY, G.**
Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- DUFFY, PAUL**
Russian realities p 4 A92-53250
- DUFOUR, ALAIN**
Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- DUFOUR, FRANCOIS**
Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
- DUGEAI, A.**
Prediction of generalized aerodynamic forces following linearized supersonic theory [ONERA, TP NO. 1991-114] p 9 A92-16093
- DUHAMEL, T.**
Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- DUMMER, K.**
SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859
- DUNHAM, J.**
The changing role of experimentation in aeroengine R and D: The point of view of the research worker [AD-A246372] p 100 N92-27062
- DUPOIRIEUX, FRANCIS**
Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
- DUPONCHEL, JEAN PIERRE**
Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
- DUPONT, P.**
A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
Hot-wire measurements in turbulent transonic flows p 26 A92-53078
Spectral analysis with a LDA in high speed flow p 209 A92-54339
- DUPRIEZ, F.**
Design and manufacturing of torsional flexible blade models p 71 A92-35780
Flutter models: Their design, manufacture, and ground testing p 109 N92-34164
- DUPUY, PHILIPPE**
A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- DURAND, P.**
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- DURAO, D. F. G.**
Turbulent energy budgets in impinging zones p 17 A92-40081
Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
- DURIN, CHRISTIAN**
New results from FRECOPA analysis p 213 N92-27304
- DUSSAUGE, J. P.**
Hot-wire measurements in turbulent transonic flows p 26 A92-53078
- DUTOYA, D.**
Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- DUVAUT, GEORGES**
Modeling and computation of composite materials [ONERA, TP NO. 1992-50] p 144 A92-48611
- DUWE, H.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- DUYZER, JAN**
A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
- DYER, C. S.**
Surface activation of Concorde by Be-7 p 271 N92-23295
- DZYGADLO, Z.**
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
- ## E
- EAST, R. A.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5084] p 69 A92-31691
Interference heating near fin/body junctions on hypersonic vehicles p 36 N92-14996
The dynamic response of separated hypersonic flows p 38 N92-15019
- EAST, ROBIN A.**
Atmospheric re-entry p 123 A92-33409
- EATON, R. A.**
The impact of air transport on the environment [PNR-90876] p 230 N92-33751
- EATWELL, G. P.**
A survey of active control in aircraft cabins p 72 A92-39084
- EBELING, W.-D.**
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- EBERLE, A.**
CFD contributions during hypersonic airplane intake design p 199 N92-27472
Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
CFD contributions during hypersonic airplane intake design [MBB/FE213/S/PUB/459] p 50 N92-30676
- EBERLE, ALBRECHT**
Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 N92-21704
- ECCLES, E. S.**
Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379
- ECE, MEHMET C.**
The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449
- ECIJA, J. B.**
Fuzzy guidance system evaluation p 259 N92-27903
- ECKHARD, F.**
High performance capillary electrophoresis in microgravity environment p 206 A92-20996
- ECKOLD, G. C.**
Joining of composite materials to metals p 211 A92-10695
- EDWARDS, D. P.**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- EDWARDS, GERALDINE F.**
Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793
- EDWARDS, J. A.**
High temperature superconducting vortex flow transistor p 159 A92-38971
- EDWARDS, JOHN A.**
Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830
- EGGER, JOSEPH**
Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
- EGOROV, A. V.**
Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
- EHRENDORFER, MARTIN**
Four-dimensional data assimilation - Comparison of variational and sequential algorithms p 239 A92-51783
- EHRET, GERHARD**
Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- EIBL, HERBERT**
Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- EICH, T.**
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- EIDEN, M.**
Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
- EILERSEN, N.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- EISENLOHR, HOLGER**
A short or a long cylinder: What difference does it make to the Karman vortex street? [MPIS-98/1990] p 40 N92-17314
- ELANDS, P. J. M.**
The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- ELDER, R. L.**
Radial inflow turbine study [AD-A240169] p 96 N92-11015
Radial inflow turbine study [AD-A246938] p 101 N92-28073
Radial inflow turbine study [AD-A252783] p 214 N92-33538
- ELIAS, G.**
Characterization of subcritical and supercritical jets by an acoustic imagery method [ONERA, TP NO. 1992-34] p 267 A92-48595
- ELIASSON, P.**
Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026
- ELIASSON, PETER**
Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168
- ELIPE, A.**
Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728
- ELLENBROEK, M. H. W.**
Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 N92-28650
- ELLIN, A. D. S.**
Tail rotor aerodynamic features recorded in flight p 70 A92-35752
- ELLIOT, SIMON**
Flying on thin ice p 54 A92-38375
- ELLIOTT, I. C.**
MA alloys for aerospace applications p 149 A92-26128
- ELLIOTT, SIMON**
Damping down the fires p 53 A92-25075
The other missiles p 2 A92-28184
Mass-transporter p 69 A92-34650
- ELLIS, D. C.**
A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795
- ELLIS, JOHN A.**
Skylark sounding rockets - Past and present p 286 A92-30108
- ELLIS, KEN**
Airbus - The family expands p 2 A92-30092

ELSENAAR, A.

- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
- The windtunnel as a tool for laminar flow research [NLR-TP-90145-U] p 117 N92-28661
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 N92-32732
- EMBACHER, E.**
Application of CFD tools in space projects p 197 N92-25897
- EMBORG, URBAN**
Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085
Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- EMERSON, D. R.**
A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications) [AERO-REPT-9002] p 190 N92-18088
Computation of laminar flow over cavities [AERO-REPT-9013] p 191 N92-18235
- ENCENAZ, P.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- ENGHOLM, C.**
Lightning activity in microburst producing storm cells [ONERA, TP NO. 1991-98] p 235 A92-16080
- ENGLE, R. H.**
Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- ENGLISH, S. J.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- ENGLUND, J.**
Esrange: Sounding rocket and balloon facility p 126 N92-20720
- ENSELME, MICHEL**
Parallel computing - An indispensable tool for the numerical simulation of tomorrow [ONERA, TP NO. 1991-196] p 255 A92-26355
- ENTSTRASSER, NORBERT**
Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
- ERCE, I.**
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
- ERIKSSON, K.**
The 2D-computation of an axial fan with FINFLO [PB92-180678] p 203 N92-30023
- ERISMAN, JAN-WILLEM**
A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
- ERKELENS, L. J. J.**
Development of new flight procedures for the Microwave Landing System (MLS) [NLR-TP-91156-U] p 66 N92-32830
- ERNST, G.**
The transpirator, an efficient and light evaporative cooler for space technology p 154 N92-26986
- ERRERA, M.**
Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- ESCANDE, BEATRICE**
Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- ESCHBAUMER, HERMANN**
Repair procedures for advanced composites for helicopters p 4 A92-56277
Repair procedures for advanced composites for helicopters [MBB-UD-0606-91-PUB] p 5 N92-29874
- ESCHENAUER, H. A.**
Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- ESKELINEN, PEKKA**
A computerized flight inspection system p 61 A92-43881
- ESTENNE, MARC**
Rib cage shape and motion in microgravity p 247 A92-56944
- EULER, MICHAEL**
Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312
- EVANS, A.**
Mesh adaptivity with the quadtree method p 22 A92-47041

- Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- EVANS, LES**
Fixed wing night attack EO integration and sensor fusion p 253 N92-19009
- EVANS, R. H.**
Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
- EVERSON, H.**
Steels for aerospace applications p 149 A92-52983
- EWALD, J.**
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017

F

- FABIAN, A. C.**
Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- FABIGNON, YVES**
Computer codes for ballistic performance calculations of base bleed propellant grain p 17 A92-39433
- FABRIS, M.**
Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- FAHNENBRUCK, GERHARD**
Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates [DLR-FB-91-23] p 64 N92-20902
- FAHY, F. J.**
Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086
- FALCHETTI, FREDERIC**
Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701
- FALCINELLI, D.**
Limitations on helicopter operations in the aeronaval environment p 82 N92-21973
- FALCON RAVELO, JUAN F.**
Aircraft financing in Spain p 280 A92-35593
- FARAH, IAD ANTON**
Numerical solutions for uniform flow around symmetrical bodies using panel methods [AERO-REPT-9014] p 192 N92-18320
- FARGE, M.**
Continuous wavelet analysis of coherent structures p 203 N92-30673
- FARGE, MARIE**
Wavelet transforms and their applications to turbulence p 177 A92-45091
- FARLEY, JOHN**
Tomorrow's Goshawk flies p 68 A92-18001
- FARMER, A. D.**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- FARMER, ERIC**
Stress and error in aviation p 249 A92-13015
Human resource management in aviation p 250 A92-13837
- FASSI, F.**
AM-X flight simulator from engineering tool to training device p 116 N92-28536
- FAUCHAIS, P.**
Diagnostics of thermal spraying plasma jets p 213 A92-55403
- FAURE, J. C.**
Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 N92-14042
- FAVINI, B.**
Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
- FAVINI, BERNARDO**
A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
- FAVOT, JEAN-JACQUES**
Concept for future cockpits p 88 A92-16148
- FEARN, D. G.**
The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
- FEGETTER, AMANDA J. W.**
The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994

FEIJOO, C.

- New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
- FELCMAN, JIRI**
Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
- FELIZIANI, C.**
Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- FENN, M. A.**
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- FERRER, JACQUES**
From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368
- FERMIGIER, M.**
Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
- FERNANDEZ DE LA MORA, J.**
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- FERNANDEZ-FERIA, R.**
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- FERRANTE, MARIO**
A product assurance engineering concept for complex space systems p 216 N92-18645
- FERRAZZOLI, P.**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- FERRER-PELLICER, D.**
Fast finite element solvers for reentry flows p 35 N92-14988
- FERRET, B.**
Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
- FERRETTI, A.**
Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
- FERRUA, BERNARD**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- FEY, J.**
Expert system for the Tornado ground-based check-out system p 91 N92-12536
- FIDDES, S. P.**
An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770
- FIDRANSKY, JIRI**
The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- FIEBRICH, H. K.**
Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- FIGAROL, SYLVIE**
Knowledge transfer and anticipation in airline piloting p 250 A92-45065
- FIMPEL, HANS P.**
The DLR meteorological research aircraft Falcon p 240 N92-26348
- FIMPEL, HANS-P.**
Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
- FINKENZELLER, H.**
Preconsiderations on aircraft integration p 224 N92-23402
- FINLAY, B. A.**
United Kingdom approach to deriving military ship helicopter operating limits p 82 N92-21966
- FIRMIN, J. L.**
Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 N92-26974
- FISCHER, J.**
Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 N92-22180
- FLAMANT, C.**
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- FLAMANT, P.**
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- FLAMANT, P. H.**
Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037

- FLAMENT, C.**
Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 N92-15029
- FLATMAN, J. C.**
Surface activation of Concorde by Be-7 p 271 N92-23295
- FLECKENSTEIN, H.**
A systematic formulation, as an approach to air traffic [MBB-Z-0371-91-PUB] p 62 N92-10996
- FLEISCHMANN, A.**
AS 332 MKII - Development and certification p 75 A92-56343
- FLEYGNAC, D.**
Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
- FLICKE, H.-P.**
Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 N92-23844
- FLITCROFT, J. E.**
Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- FLOURENS, F.**
Lightning strike simulation using coaxial line technique and 3D linear injection current analysis p 159 A92-20131
- FLOUTI, REALY**
Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
- FOLLARD, J.**
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
- FOLTRAN, DANILO**
A product assurance engineering concept for complex space systems p 216 N92-18645
- FONTAINE, SOPHIE**
A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
- FONTAN, JACQUES**
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- FOOT, J. S.**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- FORBRICH, D.**
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951
- FORD, PETER G.**
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679
- FORMAGGIA, L.**
Simulation of hypersonic flows on unstructured grids p 15 A92-31496
Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- FORMAGGIA, LUCA**
An unstructured mesh generation algorithm for three-dimensional aeronautical configurations p 262 A92-47053
- FORMANEK, B.**
Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- FORNASIER, LUCIANO**
Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675
- FORRESTER, D. A.**
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605
- FORTESCUE, PETER W.**
Spacecraft systems engineering [ISBN 0-471-92794-5] p 120 A92-33401
Dynamics of spacecraft p 123 A92-33404
- FOSS, B.**
Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- FOTEA, K.**
Three dimensional flow in sharp bends p 200 N92-27481
- FOUILLET, Y.**
Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- FOUILLOT, J. P.**
Vigilance of aircrews during long-haul flights p 247 A92-45021
- FOUQUART, Y.**
Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354
- FOURCADE, J.**
The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
- FOURNIER, G.**
Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353
- FOURNIER, J.**
Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020
- FOURNY-DELLOYE, D.**
Main activities conducted under the International Space Year Panel of Experts on Education and Applications [IAF PAPER 92-0466] p 274 A92-55806
- FOURQUET, J. M.**
Communication satellite system beyond the year 2000 [IAF PAPER 91-495] p 155 A92-18509
- FRAAS, PAUL**
Tornado structural fatigue life assessment of the German Air Force p 79 N92-18592
- FRAEDRICH, WERNER M.**
Tool supported software development experiences from the EFA project p 256 N92-12451
- FRANCA, LEOPOLDO P.**
Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 N92-24963
- FRANCOIS, G.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- FRAY, J. M. J.**
System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
- FREDRIKSSON, BILLY**
A manufacturer's approach to ensure long term structural integrity p 57 N92-30133
- FREEMAN, K. S. C.**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- FREEMAN, M. P.**
Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
- FRIEDEMUTH, PAUL**
Transfers of technology: International negotiations and work in progress p 278 N92-18665
- FRICKER, JOHN**
Rafale M - Dassault's Squall at sea p 71 A92-37874
- FRIEBEL, C.**
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
- FRIEDRICH, H.-E.**
Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742
- FRIEDRICH, R.**
Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023
- FRIIS-CHRISTENSEN, E.**
Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
- FRISCH, B.**
Why quantify risk? p 153 N92-18637
- FRISCHBIER, J.**
Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP p 219 N92-14420
- FROMONT, B.**
Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- FRYER-TAYLOR, R. E. J.**
Flow structure and mixing in obstructed and confined jets p 174 A92-40107
- FU, Y.**
Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
- FUCHS, L.**
Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967
- Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599
- FULACHIER, L.**
Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
- FULLER-ROWELL, T. J.**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- FULTON, KEN**
CIS engines. I - The range revealed p 4 A92-47821
CIS engines - The range revealed. II p 96 A92-54546
- FUNG, J. C. H.**
Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
- FURINI, F.**
Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
- FURNISS, TIM**
Reducing risks p 278 A92-22725
- FUYKSCHOT, P. H.**
Model incidence measurement using SAAB ELOPTOPOS system [NLR-TP-89182-U] p 115 N92-18416

G

- GAFFIE, D.**
G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
Circulatory biomechanics effects of accelerations p 248 N92-18991
- GAFFIE, DANIEL**
Study of the loss of consciousness inflight by fighter aircraft pilots [ONERA-RTS-11/3446-EY] p 249 N92-28844
- GAGNON, YVES**
Numerical flow visualization of high Reynolds number recirculated flows using an animation technique [ONERA, TP NO. 1991-215] p 168 A92-26367
- GAIDA, M.**
Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- GAIDAROVA, S. G.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- GAILLARD, R.**
Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines [ONERA, TP NO. 1991-170] p 110 A92-16135
- GAILLARDON, J. M.**
Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- GALANTUCCI, L. M.**
An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
- GALBRAITH, R. A. MCD.**
An experimental investigation of the oblique blade-vortex interaction p 19 A92-43447
Measurements of the dynamic stall vortex convection speed p 27 A92-56351
- GALEA, E. R.**
A fire field model implemented in a parallel computing environment p 166 A92-23252
- GALFETTI, L.**
Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
- GALLE-TESSONNEAU, J. R.**
The pilot flight surgeon bond p 250 N92-13548
Fear of flying p 251 N92-13556
- GALLICE, G.**
Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- GALLON, M.**
Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 N92-11308
- GALLOWAY, E. M.**
Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- GAN, X. P.**
Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317
- GARCIA, JEAN M.**
Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751

- GARCIAFOGEDA, P.**
Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
- GARDAREIN, P.**
Aerodynamic computations of high-speed transonic propellers
[ONERA, TP NO. 1991-218] p 13 A92-26370
- GARDETTE, G.**
Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
Application of infrared thermography to thermal flux measurement in wind tunnels p 112 N92-11020
Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 N92-15003
- GARDINER, PETER T.**
Fibre optic rotary position sensors for vehicle and propulsion controls p 90 A92-46243
- GAREM, H.**
Control aspects of the transition from transversal to transonic flow, step effects
[ETN-91-90106] p 29 N92-11981
- GARRONE, ANGELO**
An overview of the planned aerospace test facilities at Capua, Italy
[AIAA PAPER 92-3944] p 112 A92-56773
- GASBARRI, P.**
Gust effects on a flexible aircraft p 68 A92-22474
- GASH, J. H. C.**
Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
- GASTER, M.**
Separation of relaminarised boundary layers
[CUED/A-AERO/TR-16] p 195 N92-22209
- GATHMANN, R. J.**
Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
- GATIGNOL, RENEE**
Transport coefficients in discrete kinetic theory and comparison with classical fluid dynamics p 274 A92-52782
- GATO, L. M. C.**
An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206
- GAUME, BRUNO**
A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- GAUTHIER, D.**
Lightning strike simulation using coaxial line technique and 3D linear injection current analysis p 159 A92-20131
- GAUTHIER, S.**
Modelling compressible turbulent mixing p 178 A92-45094
- GAVE, G.**
Different space electrochemical conversion and storage systems p 140 A92-40455
- GAY, J.**
Some direct methods in electromagnetism p 265 A92-47921
- GAYET, J.-F.**
Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds p 53 A92-23302
- GELY, D.**
Study of noise generated by the impingement of a hot supersonic jet on an obstacle
[ONERA, TP NO. 1992-33] p 267 A92-48594
Characterization of subcritical and supercritical jets by an acoustic imagery method
[ONERA, TP NO. 1992-34] p 267 A92-48595
- GENNARETTI, M.**
A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
- GENT, R. W.**
A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
- GEOFFROY, P.**
Design and manufacturing of torsional flexible blade models p 71 A92-35780
- GEORGALA, J. M.**
The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
- GEORGIOU, G.**
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
- GERICKE, W.**
Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649
- GERMANO, M.**
An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
Turbulence - The filtering approach p 175 A92-41656
- GERMANO, MASSIMO**
A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
- GEROLYMOS, G. A.**
Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- GEROLYMOS, GEORG A.**
On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
- GERRARD, J. H.**
Vorticity measurements in the near wake of a bluff body at low Reynolds numbers
[AERO-REPT-9102] p 195 N92-22100
- GERTEISEN, EDGAR A.**
Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
- GEURTS, B. J.**
A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence
[MEMO-1009] p 202 N92-29972
- GHARIB, C.**
Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest
[IAF PAPER 91-550] p 246 A92-18547
- GIACOBBI, T.**
Proposal for the new fatigue management system for the AMX p 78 N92-18580
- GIACOMELLI, G.**
Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
- GIANNAKIDIS, GEORGE**
Calculation of potential flow around airfoils using a discrete vortex method p 21 A92-45827
- GIANNAKOGLU, K.**
Turbine cascade calculations through a fractional step Navier-Stokes algorithm
[ASME PAPER 91-GT-55] p 7 A92-15533
Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- GILBANK, PASCALE**
Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models
[ONERA, TP NO. 1991-110] p 163 A92-16089
Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock
[ESA-TT-1229] p 148 N92-31942
- GILBERT, NEIL**
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
- GILDERT, R. G.**
An aerodynamic consideration of the re-entry and aerobraking environment of space vehicles
[IAF PAPER ST-92-0017] p 27 A92-57363
- GILL, E.**
Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755
- GILMORE, M. R.**
Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- GILMOUR, J. D.**
Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284
- GILTHORPE, M. S.**
Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808
- GINDER, R. B.**
Design and performance of advanced blading for a high-speed HP compressor
[ASME PAPER 91-GT-374] p 9 A92-15718
- GIORDANO, D.**
SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999
- GIRARD, ANDRE**
Environmental impact of a future supersonic transport aircraft
[ONERA, TP NO. 1991-132] p 226 A92-16108
- GIRARD, M.**
Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring
[AAAF-NT-89-28] p 185 N92-11288
Thermographic gust wind tunnel measurements
[ONERA-RF-31/3409-PY] p 29 N92-11972
- GIROUDROUX-LAVIGNE, P.**
Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method
[ONERA, TP NO. 1992-1] p 23 A92-48577
Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration
[ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- GISQUET, D.**
Detailed analysis of wing-nacelle interaction for commercial transport aircraft
[ONERA, TP NO. 1991-152] p 9 A92-16122
- GIZDOVA, N. D.**
Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
- GLAISTER, DAVID H.**
Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
- GLASSMEIER, KARL-HEINZ**
Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089
- GLOVER, K.**
VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561
Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094
- GMEHLING, J.**
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- GOBEL, TERESA M.**
Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge
[AD-A241072] p 232 N92-13512
- GODARD, J. L.**
Detailed analysis of wing-nacelle interaction for commercial transport aircraft
[ONERA, TP NO. 1991-152] p 9 A92-16122
Drag prediction using computation methods
[ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682
- GODDARD, K.**
Environmentally sound
[PNR-90776] p 228 N92-21743
Re-engining for real stage 3 compliance
[PNR-90872] p 102 N92-33748
- GODDARD, N. D. R.**
Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990
[ISBN 0-85498-530-1] p 144 A92-45335
- GODIN, S.**
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
- GOELLNER, AMBROS**
Tornado structural fatigue life assessment of the German Air Force p 79 N92-18592
- GOELZENLEUCHTER, HORST**
Test and integration concept for complex helicopter avionic systems p 90 A92-56292
- GOERANSSON, PETER**
Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956
- GOETHALS, CHRISTOPHE**
A practical experience of Ada for developing embedded software p 257 N92-12465
- GOETZENDORF-GRABOWSKI, TOMASZ**
Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method p 105 A92-47779
- GOGOSHEV, M. M.**
An example of space technological transfer in a small country
[IAF PAPER 92-0178] p 282 A92-55636
- GOKER, MEHMET H.**
The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
- GONZALEZ, D.**
Criticality management in space programs p 275 N92-18619
- GONZALEZ, L.**
Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- GONZALEZ, M.**
Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475

- GONZE, M. A.**
Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- GOODEN, J. H. M.**
Comparison of LDA and LTA applications for propeller tests in wind tunnels [NLR-MP-88031-U] p 47 N92-28658
Selection of a laser anemometer technique for propeller tests in wind tunnels [PB92-138510] p 118 N92-70563
- GOODISMAN, M. I.**
An Axial Turboprop [ASME PAPER 91-GT-1] p 211 A92-15501
- GOODMAN, P. J.**
Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 N92-27888
- GOODYER, MICHAEL J.**
Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 N92-27804
- GOOLD, IAN**
Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
Ageing airliner census - Still flying safely p 54 A92-38374
- GOOSSENS, M.**
Modelling stellar surface magnetic fields. I - Search strategies and uniqueness p 283 A92-14147
- GORANSSON, PETER**
Propeller aircraft interior noise - Physical background and possible treatments p 71 A92-39082
- GORDON, ALASTAIR C.**
The 1991 Cierva Lecture - Aberdeen and its influence on the evolution of the commercial IFR twin engined helicopter p 55 A92-43446
- GORINI, MASSIMO**
Rib cage shape and motion in microgravity p 247 A92-56944
- GORIS, WILFRED**
Security rights in aircraft under Belgian law p 280 A92-35589
- GOTBERG, YNGVE**
Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779
- GOTTESDIENER, L.**
Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 N92-11979
Flat plates placed in depleted hypersonic flow [SESSIA-430/91-960] p 50 N92-31508
- GOULARD, JACQUES**
Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 N92-27148
- GOUDENOVE, FRANCOIS**
ELS for the A340 [SAE PAPER 912111] p 89 A92-39963
- GOULAIN, M.**
Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
- GOULAS, A.**
Three dimensional flow in sharp bends p 200 N92-27481
- GOULD, R. D.**
The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
- GOUSSET, G.**
Rotational temperature measurements in an arc jet p 177 A92-44395
Rotational temperature measurements of N2(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982
- GOW, P. J.**
The design of spaceborne synthetic aperture radar [ETN-91-99986] p 156 N92-10114
- GOYAL, PHILIP**
Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353
- GRAF, WALTER H.**
On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
- GRAFFSTEIN, JERZY**
Selected models of aircraft navigation space p 61 A92-45373
- GRAHAM, J.**
Effect of viscous damping on the response of floating bodies p 187 N92-14303
- GRAHAM, J. M. R.**
Numerical simulation of vortex street-edge interaction p 33 N92-13027
- GRAHAM, JOHN M.**
Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
- GRAHAM, W. R.**
Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201
- GRALLERT, H.**
Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB/FE202/S/PUB/461] p 5 N92-30232
- GRAMBOW, K.**
Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
- GRANDE, M.**
The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- GRANDJEAN, CLAUDE**
A practical experience of Ada for developing embedded software p 257 N92-12465
- GRANOIEN, I. L. N.**
Advanced method for single event aircraft noise analysis p 266 A92-39060
- GRANOIEN, IDAR L. N.**
Computation of aircraft noise exposure using digitized topography data p 227 A92-39058
- GRANT, I.**
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- GRANT, W. B.**
Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition p 229 N92-29304
- GRAPPERON, J.**
Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926
- GRASSIN, CHRISTOPHE**
Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 N92-15040
- GRASSO, F.**
Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
- GRAU, JEAN Y.**
Knowledge transfer and support systems in fighter aircraft p 251 A92-45047
- GRAVELLE, A.**
Aircraft ground vibration test by means of flight control surfaces [ONERA, TP NO. 1991-96] p 103 A92-16079
- GRAVELLE, ALAIN**
Advances in aircraft modal identification [ONERA, TP NO. 1992-47] p 105 A92-48608
- GRAVE, J.**
Grid impact on 3D hypersonic flows p 39 N92-15041
- GRAY, EDWIN M.**
Requirements p 255 A92-19382
- GRAZIANI, F.**
Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
- GREEN-THOMAS, T.**
Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244
- GREEN, INGE S.**
Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952
- GREEN, J. E.**
The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum p 15 A92-32323
- GREEN, R.**
Pilot attitudes to cockpit automation p 250 A92-44926
- GREEN, R. B.**
Measurements of the dynamic stall vortex convection speed p 27 A92-56351
Vorticity measurements in the near wake of a bluff body at low Reynolds numbers [AERO-REPT-9102] p 195 N92-22100
- GREEN, STUART**
Aspects of compression in aerospace composites: Future requirements p 146 N92-33036
- GREENER, B.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- GREFF, E.**
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951
- GREGORIS, GUY**
Future technologies for space: New product assurance concepts p 153 N92-18650
- GREGORY-SMITH, D. G.**
Turbulence modelling for secondary flow prediction in a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
- GREITZER, E. M.**
Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464
- GRETHER, W.**
Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
- GRIGUERE, HENRI**
Flight management system back-up navigation for the A330/A340 aircraft p 106 A92-49326
- GRIMM, W.**
Optimal guidance anticipating missile performance p 128 N92-27902
- GRISVAL, J. P.**
Direct coupling of fluid structure in transonic aeroelasticity p 46 N92-27954
- GROPENGISSER, F.**
Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734
Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
- GROSSIN, J.**
The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
- GROTOWSKY, I.**
Supersonic flow in compression stages and inlets p 43 N92-24395
- GRUNDY, R. E.**
A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574
- GUEGAN, M. C.**
Hypersonic wakes [ETN-92-91082] p 41 N92-19925
- GUELL, A.**
Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547
- GUENTHER, G.**
Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
- GUERMOND, JEAN-LUC**
An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724
A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- GUERNIGOU, J.**
Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
- GUEZENNEC, C. Y.**
Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- GUEZENNEC, Y.**
Continuous wavelet analysis of coherent structures p 203 N92-30673
- GUFFOND, DIDIER**
Aircraft icing [ONERA, TP NO. 1991-202] p 54 A92-26359
- GUGLIERI, G.**
Experimental investigation of vortex dynamics on delta wings [AIAA PAPER 92-2731] p 21 A92-45565
- GUIBERT, L.**
Avionics standardization in Europe p 91 N92-14050
- GUICHETEAU, PH.**
Utilization of a research simulator for the development of new flight control concepts [ONERA, TP NO. 1991-161] p 110 A92-16128
Use of a research simulator for the development of new concepts of flight control p 116 N92-28543
- GUILLARD, H.**
Adaptive spectral methods with application to mixing layer computations p 182 A92-52404
- GUILLAUD, V.**
Influence of microvibrations on spacecraft performances p 134 N92-23825
- GUILLAUME, A.**
G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
Circulatory biomechanics effects of accelerations p 248 N92-18991
- GUILLAUMON, JEAN-CLAUDE**
Spacecraft thermal control coatings p 151 N92-24829
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

- GUILLOT, J.**
International standardisation of regulations for gust loading calculations p 68 A92-22473
- GUIVER, E. J.**
Approach and landing guidance p 65 N92-21960
- GULCAT, U.**
3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
- GUNDERSEN, ARNE**
The Norwegian space programme p 121 A92-53453
The Norwegian sounding rocket and balloon programme p 122 N92-24594
- GUNNINK, JAN W.**
Aerospace Arall - A challenge for the aircraft designer p 143 A92-10232

- GUPTA, S.**
A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- GUSTAVSSON, LARS**
Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087
Acoustic characteristics of anechoic chamber at FFA [FFA-TN-1990-43] p 268 N92-12599
- GUYENNE, T. D.**
Activities report of the European Space Agency [ETN-92-90679] p 286 A92-15961
- GUYENNE, T.-D.**
Promotion of industrial development and utilisation of microgravity in space: The Radius report p 152 N92-19413
Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
- GUYENNE, T.-DUC**
Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668
Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
- GUZAS, DANIELJUS**
Acoustic isolation of layers p 265 A92-12345

H

- HAARMMEYER, J.**
Computation and visualization of specific flow phenomena in turbomachinery application p 100 N92-27463
- HABIGER, H.**
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- HACHEM, FAROUK H.**
Boundary layer transition on concave surfaces p 195 N92-22200
- HACK, G. A. J.**
MA alloys for aerospace applications p 149 A92-26128
- HACK, THEODOR**
New accelerated corrosion test methods [MBB-Z-0406-91-PUB] p 150 N92-32895
- HADDAD, B.**
Vectorising the smooth particle hydrodynamics p 161 A92-10037
- HADZIDAKIS, M.**
Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- HAENEL, D.**
Computational techniques for solving the Navier-Stokes equations p 198 N92-27451
- HAERING, R.**
Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- HAERTING, ALEXANDER**
Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721
- HAUSER, J.**
A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026
Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030
Grid impact on 3D hypersonic flows p 39 N92-15041
- HAGEN, MARTIN**
Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342

- HAGMEIJER, R.**
LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983
- HAHN, K.-U.**
ATTAS flight test and simulation results of the advanced gust management system LARS [AIAA PAPER 92-4343] p 106 A92-55332
- HAHN, W.**
Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- HAINES, A. B.**
Survey of experimental techniques for performance prediction p 84 N92-23954
- HAINES, J. E.**
Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- HALE, A.**
Reliability, availability, maintainability, and safety p 216 N92-18639
- HALES, F. D.**
Yacht sail aerodynamics. Part 1: Optimising overall performance [TT-8903-PT-1] p 52 N92-70499
Yacht sail aerodynamics. Part 3: Achievable jibsail specification [ISBN-0-904947-17-3] p 52 N92-70513
Yacht sail aerodynamics. Part 2: Achievable mainsail specification [ISBN-0-904947-16-5] p 52 N92-70514
- HALL, D. S.**
The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- HALL, I. M.**
Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231
Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232
- HALL, J. R.**
Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546
- HALL, P.**
Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
- HALL, PHILIP**
The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
Instability and transition in compressible boundary layers [AD-A248596] p 201 N92-28062
- HALLDORSSON, TH.**
Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- HALVORSEN, I.**
Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- HALVORSEN, WILLIAM G.**
Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085
- HAMACHER, HANS**
Spacecraft low frequency residual acceleration [IAF PAPER 92-0970] p 133 A92-57328
- HAMAN, KRZYSZTOF E.**
A new thermometric instrument for airborne measurements in clouds p 88 A92-24918
- HAMDI, M. A.**
A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 N92-23846
- HAMI, S.**
Radial inflow turbine study [AD-A246938] p 101 N92-28073
- HAMID, S.**
Radial inflow turbine study [AD-A240169] p 96 N92-11015
Radial inflow turbine study [AD-A252783] p 214 N92-33538
- HAMINH, H.**
Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
- HANCOCK, P. E.**
Three-dimensional separated flows p 173 A92-40088
- HANER, D.**
Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306

- HANINE, F.**
Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
- HANKE, D.**
The role of systems simulation for the development and qualification of ATTAS p 117 N92-28548
- HANNAPPEL, R.**
Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023
- HANNIGAN, RUSSELL J.**
The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510
- HANOTEL, R.**
Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
- HANSBO, PETER**
A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
- HANSELMANN, H.**
Code generation for fast DSP-based real-time control p 257 N92-12462
- HANSEN, N.**
The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- HANSON, A. W.**
Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
- HAQ, Z. U.**
Interference heating near fin/body junctions on hypersonic vehicles p 36 N92-14996
- HARASGAMA, S. P.**
Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 N92-14319
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466
- HARLOW, F. H.**
A spectral model for turbulent transport p 178 A92-45095
- HARRIS, DON**
The development of a working model of flight crew underload p 249 A92-13019
The importance of the Type II error in aviation safety research p 250 A92-13027
- HARRIS, I. L.**
Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- HARRIS, M. R.**
The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300
- HARRIS, TRACY**
The long-term psychological consequences of a major aircraft accident p 249 A92-13020
- HARRISON, D.**
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946
- HARTERMANN, WOLFGANG**
Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691
- HARTJES, FREDERIK GOTTLIEB**
A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 N92-17434
- HARTMANN, K.**
Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- HARTQUIST, T.**
Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800
- HARTZHEIM, W.**
Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424

- HARVEY, GILES**
The Rolls-Royce Trent
[PNR-90875] p 88 N92-33750
- HARVEY, J. K.**
Heat transfer to a delta wing and two waverider wings
in rarefied hypersonic flow p 25 A92-52748
- HARVEY, S.**
SOHO: A challenge in spacecraft thermoelastic design
and verification p 139 N92-25859
- HASSAN, O.**
The computation of three-dimensional flows using
unstructured grids p 16 A92-37539
The numerical simulation of flow about installed aero
engine nacelle using a finite element Euler solver on
unstructured meshes p 26 A92-52848
- HATON, J.-P.**
Real-time mechanisms in a multibase knowledge
system p 264 A92-20345
- HAUCK, HELMUTH**
The German Hypersonics Technology Programme -
Status report 1992
[IAF PAPER 92-0867] p 127 A92-57258
- HAUF, THOMAS**
Aircraft observation of a small-scale solitary wave near
the tropopause p 234 A92-26336
- HAUGAN, PETER M.**
Characterization of air-ice-ocean interactive processes
in the MIZ based on SAR derived ice edge
configurations p 242 A92-34943
- HAUGER, MICHAEL**
German-GUS cooperation in civil aviation
p 3 A92-47592
- HAUGLI, HANS-CHR.**
Implementation of inmarsat mobile satcom systems
p 157 N92-24073
- HAUPT, L.**
Collection of product assurance data and their effective
utilization p 216 N92-18651
- HAUSAMANN, D.**
Airborne far-infrared heterodyne remote sensing of
stratospheric OH - A feasibility study p 231 A92-52876
- HAUSER, DANIELE**
Measurements of ocean wave spectra with the RESSAC
airborne radar p 89 A92-35256
- HAUSER, T.**
Testing high order shock-capturing schemes in 2D super-
and hypersonic flows p 38 N92-15023
- HAUSKNECHT, P.**
CO₂ laser active remote sensing from 9 to 11 microns:
Airborne and laboratory application p 223 N92-11535
- HAYNES, O.**
Charged dust in the earth's mesopause - Effects on
radar backscatter p 231 A92-41800
- HAWKINS, GARY J.**
Exposure to space radiation of high-performance
infrared multilayer filters and materials technology
experiment (A0056) p 272 N92-27108
- HAY, N.**
Discharge coefficients of cooling holes with radiused
and chamfered inlets
[ASME PAPER 91-GT-269] p 162 A92-15667
- HAYMANN, J. PH.**
G-LOC. Gz and brain hypoxia. Gz/s and intracranial
hypertension p 248 N92-18984
- HE, L.**
Inviscid-viscous coupled solution for unsteady flows
through vibrating blades. II - Computational results
[ASME PAPER 91-GT-126] p 8 A92-15571
An experiment on unsteady flow over an oscillating
airfoil
[ASME PAPER 91-GT-181] p 8 A92-15613
- HEAD, N.**
The integration and test of modern spacecraft control
systems p 261 N92-20601
- HEARD, P. J.**
Aircraft gas turbine emissions: Their nature, technology
for reduction, and a pollution comparison with channel
tunnel transport
[ETN-92-91056] p 99 N92-22406
- HEARNE, PETER A.**
Anglo-American avionics p 2 A92-25575
- HEATH, R. P. G.**
A dynamics parameter invariant attitude control system
for flexible spacecraft p 130 A92-15384
- HEBEKER, F. K.**
On missing boundary conditions with unsteady
incompressible Navier-Stokes flows p 183 A92-53124
- HEBERS, H.**
Set-up and alignment aspects of a CO₂-laser radar for
applications in the field
[FEL-91-A162] p 158 N92-25378
- HEDDERGOTT, A.**
Application of a wall pressure method in a wind tunnel
test section with adjustable longitudinal slots
p 112 A92-54336
- HEDGE, B.**
Electronically steerable antenna for aircraft
p 156 N92-15272
- HEDMAN, SVEN G.**
MATGRID: A program for generation of C-H and C-O
topology grids around wing/body configurations.
Mathematical definition document
[FFA-TN-1990-19] p 41 N92-20468
MATGRID, a program for generation of C-H and C-O
topology grids around wing/body configurations: Software
description document
[FFA-TN-1990-20] p 50 N92-30713
- HEEL, FRANZ**
Radiometric calibration of an airborne C-band synthetic
aperture radar p 62 A92-53731
- HEFFNER, K. S.**
Numerical and experimental investigation of rarefied
compression corner flow
[AIAA PAPER 92-2900] p 23 A92-47876
Compression ramp in rarefied gas
[RC-90-08] p 29 N92-11978
- HEGEN, G. H.**
Application of electronically scanned pressure
measurement system for engine simulation tests in the
German-Dutch Wind Tunnel
[AIAA PAPER 92-4003] p 209 A92-56826
- HEINZE, P.**
Simultaneous stress and flutter optimization for the wing
of a transport aircraft equipped with four engines
p 108 N92-23238
- HEISER, W.**
Investigation of a plate-ramp-configuration by means of
laser Doppler anemometry at Mach 2.95
[AIAA PAPER 92-3956] p 112 A92-56784
- HEITOR, M. V.**
Turbulent energy budgets in impinging zones
p 17 A92-40081
The turbulence characteristics of a single impinging jet
through a crossflow p 180 A92-47676
- HELGER, A.**
Esrange: Sounding rocket and balloon facility
p 126 N92-20720
- HELGER, ARNE**
The Swedish space program p 121 A92-53452
- HEMKER, P. W.**
Multi-dimensional upwind schemes, multigrid and defect
correction for accurate and efficient Euler flow
computations p 35 N92-14989
- HENCKELS, A.**
Experimental study of hypersonic shock wave boundary
layer interactions by means of infrared technique
p 35 N92-14994
- HENDERSON, R.**
Concept of a European wide ground infrastructure for
experimentation in the Columbus elements Attached
Laboratory and Free Flyer
[IAF PAPER 91-105] p 119 A92-12508
- HENDERSON, ROSS**
Thermal control of spacecraft p 132 A92-33413
- HENKE, H.**
Computation of viscous phenomena in unsteady
transonic flow p 46 N92-27949
Computation of flutter boundaries in the time and
frequency domain p 46 N92-27952
- HENLEY, A. J.**
An integrated navigation system manager using
federated Kalman filtering p 90 A92-48477
- HENRI, GILLES**
Relativistic electron-positron beam formation in the
framework of the two-flow model for active galactic
nuclei p 284 A92-16523
- HENRICHFREISE, H.**
Code generation for fast DSP-based real-time control
p 257 N92-12462
- HENSHAW, JIM**
Impact of aircraft and surface emissions of nitrogen
oxides on tropospheric ozone and global warming
p 226 A92-19193
- HERLAND, EINAR-ARNE**
A SAR processor for a GIS environment
p 155 A92-34980
- HERMAN, J. R.**
Optical effects of polar stratospheric clouds on the
retrieval of TOMS total ozone p 231 A92-54645
- HERMAN, M.**
Aircraft simulations of the POLDER experiment: First
results p 223 N92-11471
- HERMANS, C.**
LAH main rotor model test at the DNW
p 70 A92-35771
LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
- HERMANSEN, D.**
Concept of a European wide ground infrastructure for
experimentation in the Columbus elements Attached
Laboratory and Free Flyer
[IAF PAPER 91-105] p 119 A92-12508
- HERNANZ, M.**
Electronically steerable antenna for aircraft
p 156 N92-15272
- HERNANZ, M. L.**
Electronically steerable antenna for aircraft
p 156 N92-15272
- HERRMANN, H.**
Diode-pumped Nd:YAG lidar for airborne cloud
measurements p 210 N92-29326
- HERTEN, M.**
Concept of a European wide ground infrastructure for
experimentation in the Columbus elements Attached
Laboratory and Free Flyer
[IAF PAPER 91-105] p 119 A92-12508
- HERZOG, P.**
Experimental study of hypersonic shock wave boundary
layer interactions by means of infrared technique
p 35 N92-14994
- HERZOG, R.**
Control concepts for active magnetic bearings
p 214 N92-27743
- HETTENA, E.**
Vortical flow simulation by using structured and
unstructured grids p 30 N92-12999
- HEWITT, F. A.**
Propulsion system performance and integration for high
Mach air breathing flight p 96 A92-46429
- HEYDEN, J.**
Opportunities for flight simulation to improve operational
effectiveness p 115 N92-28523
- HEYHOE, S.**
Low cost spacecraft attitude sensors
p 140 N92-24458
- HICKS, P.**
Quick-look system p 224 N92-23393
- HJELM, BOERJE**
Air museum p 283 N92-25761
Society of space studies p 283 N92-25762
- HIGUERA, FRANCISCO J.**
Viscous-inviscid interaction due to the freezing of a liquid
flowing on a flat plate p 163 A92-16455
- HILGENSTOCK, ACHIM**
On the simulation of compressible turbulent flows past
delta wing, delta wing-body and delta wing-canard
p 31 N92-13003
On the footprints of three-dimensional separated vortex
flows around blunt bodies: Attempts of defining and
analyzing complex flow structures p 31 N92-13005
- HILL, C. J.**
Ground surface erosion - British Aerospace test facility
and experimental studies p 111 A92-45323
- HILL, R. J.**
Compressing the compressor
[PNR-90824] p 99 N92-21848
- HILL, S. H.**
The design and testing of a radial flow turbine for
aerodynamic research
[ASME PAPER 91-GT-220] p 93 A92-15636
- HILLER, M.**
Modeling and simulation of complex mechanical systems
for space applications p 135 N92-24389
- HILLER, W. J.**
Computer-aided discrimination of slow and fast tracer
paths p 184 A92-55477
- HILLIER, H. C.**
EC funding of collaborative research projects
[PNR-90833] p 279 N92-21851
- HILLSDON, R. H.**
The design challenge of a long endurance airship
[AIAA PAPER 92-1266] p 69 A92-33344
- HINZPETER, HANS**
Investigation of convection over sea by aircraft
observations p 225 N92-26337
- HIRSCH, C.**
A multiblock/multigrid code for the efficient solution of
complex 3D Navier-Stokes flows p 188 N92-15026
An integrated CFD system for 3D turbomachinery
applications p 101 N92-27464
- HIRSCH, CH.**
Three dimensional flow in a linear compressor cascade
at design conditions
[ASME PAPER 91-GT-114] p 8 A92-15565
CFView - An advanced interactive visualization system
based on object-oriented approach
[AIAA PAPER 92-0072] p 255 A92-22185
IGG - An interactive 3D surface modelling and grid
generation system
[AIAA PAPER 92-0073] p 256 A92-22186

HIRSCH, CHARLES

Numerical computation of internal and external flows.
Vol. 2 - Computational methods for inviscid and viscous flows

[ISBN 0-471-92351-6] p 166 A92-22624

HIRSCHEL, E. H.

Aerothermodynamic challenges of the Saenger space-transportation system p 39 N92-15042

Modelling of chemical and physical effects with respect to flows around reentry bodies

[MBB-FE-211/S/PUB/0465/A] p 40 N92-19296

Saenger: The reference concept and its technological requirements - aerothermodynamics

[MBB-FE-202-S-PUB-0463-A] p 128 N92-29629

Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics

[MBB-FE-202-S-PUB-0464-A] p 48 N92-29648

Aerothermodynamics and propulsion integration in the Saenger technology programme

[MBB-FE-202-S-PUB-0469-A] p 48 N92-29649

Aerothermodynamic challenges of the Saenger space-transportation system

[MBB-FE-202-S-PUB-0462-A] p 129 N92-29680

Hypersonic flow past radiation-cooled surfaces

[MBB-FE-202-S-PUB-0468-A] p 49 N92-29713

Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle

[MBB/FE202/S/PUB/461] p 5 N92-30232

HO, AN C.

A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891

HO, C. M.

Continuous wavelet analysis of coherent structures p 203 N92-30673

HOBE, STEPHAN

Space debris - A proposal for its international legal regulation p 282 A92-51870

HOCHARD, L.

Rotational temperature measurements in an arc jet p 177 A92-44395

Rotational temperature measurements of N₂(+) in an arc jet at low pressure

[AIAA PAPER 92-2967] p 273 A92-46982

HOCKING, BARRY N.

The development of a range of low vibration mechanical cryocoolers for space application p 154 N92-25853

HODSON, H. P.

The design and testing of a radial flow turbine for aerodynamic research

[ASME PAPER 91-GT-220] p 93 A92-15636

HOEFLOOT, H. C. J.

Marangoni convection in V-shaped containers p 172 A92-37932

HOEG, J. G.

Aircraft ship operations [AGARD-AR-312] p 85 N92-28468

HOEGMAN, ULF

Esrang: Sounding rocket and balloon facility p 126 N92-20720

HOEIJMAKERS, H. W. M.

Numerical investigation into high-angle-of-attack leading-edge vortex flow

[AIAA PAPER 92-2600] p 20 A92-45477

Modelling and numerical simulation of vortex flow in aerodynamics

[AD-B163670L] p 30 N92-12997

Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing

[AD-B163639L] p 30 N92-12998

Analysis of results of an Euler-equation method applied to leading-edge vortex flow

p 30 N92-13000

An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds

p 31 N92-13011

Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds

[NLR-TP-90029-U] p 41 N92-20498

Panel methods for aerodynamic analysis and design

p 84 N92-23955

Analysis of results of an Euler-equation method applied to leading-edge vortex flow

[NLR-TP-90368-U] p 47 N92-28657

Modelling and numerical simulation of vortex flow in aerodynamics

[NLR-TP-91154-U] p 51 N92-32673

An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds

[NLR-TP-91117-U] p 51 N92-32732

Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow

[PB92-138718] p 53 N92-70577

HOELD, R.

Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 N92-22181

Case 7.4 delta wing: Navier-Stokes calculation

p 42 N92-22182

HOELD, ROLAND K.

Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008

HOELLER, HARTMUT

Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342

HOERNLEIN, H. R. E. M.

First approach to an integrated fin design p 83 N92-23236

HOFFMAN, KNUT

Pilot noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 N92-32960

HOFFMANN, HANS-EBERHARD

The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349

The icing of the elevator of the DLR icing research aircraft of Do 28 type

[DLR-MITT-91-12] p 58 N92-31813

Analysis of three icing test flights reaching the aircraft-referred icing degree of severe

[ESA-TT-1254] p 58 N92-31943

HOFFMANN, W.

Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331

HOFLAND, DICK

Tax aspects of aircraft leasing in the Netherlands p 280 A92-35588

HOFMANN, P.

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

HOGSHOLM, A.

ESA power standard p 141 N92-13174

HOINKA, KLAUS-PETER

Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday

[DLR-FB-91-30] p 233 N92-26329

HOLDEN, S. J.

Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134

HOLLY, L.

'A new proposal for an old problem' - The right engine for the right helicopter p 96 A92-56281

HOLM, INGVAR

A manufacturer's approach to ensure long term structural integrity p 57 N92-30133

HOLMAN, W.

The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

HOLOPAINEN, EERO

Decomposing the atmospheric flow using potential vorticity framework p 236 A92-21196

HOLST, H.

Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336

HOLST, HARTMUT

Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures

[DLR-FB-91-09] p 113 N92-12005

HOLTET, A.-L. RUUD

Space technology and industries in Norway [NSC-REPT(91)-8] p 153 N92-19521

HOLTET, J. A.

The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295

HOLTFORT, JOERG

Stochastic perturbed systems: Theory and practice of Karman vortex streets

[MPIS-4/1991] p 193 N92-20180

HOOG, CHARLES

Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200

HOOGBOOM, P.

First results from the Netherlands SAR testbed 'PHARS' p 221 A92-34903

HOOGSTRATEN, H. W.

Marangoni convection in V-shaped containers p 172 A92-37932

HOOMAN, HANS JUERGEN

Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 N92-32961

HOPFINGER, EMIL J.

The enigmatic merging conditions of two-layer baroclinic vortices p 162 A92-11225

HOPKINS, HARRY

Flying the A340 iron bird Delivered with feeling p 67 A92-10666

p 103 A92-16621

Through the looking glass p 90 A92-46449

Regional challenge p 74 A92-53121

HOPWOOD, S. T.

The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade

[ASME PAPER 91-GT-221] p 179 A92-46825

HORNECK, G.

Long-term exposure of bacterial spores to space p 244 N92-27126

HORNER, M. B.

An experimental investigation of the oblique blade-vortex interaction p 19 A92-43447

HORNIK, A.

Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370

HORSEMAN, NICOLA J.

The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032

HORTEL, MILAN

Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815

HORTON, G. C.

Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row

[RAE-TM-P-1205] p 187 N92-14319

Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row

p 101 N92-27466

HOSKOVA, MAHULENA

Convergence of telecommunication technologies - Some legal aspects p 281 A92-36682

HOSSAIN, M. A.

Viscous and Joule heating effects on MHD free convection flow with variable plate temperature

[DE91-633612] p 273 N92-70166

HOULT, A. P.

Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773

HOUNJET, M. H. L.

Panel method control in 3-D hyperbolic grid generation p 17 A92-39940

CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations

[NLR-TR-88154-U] p 191 N92-18221

NLR inviscid transonic unsteady loads prediction methods in aeroelasticity

p 45 N92-27947

Hyperbolic grid generation with BEM source terms

[NLR-TP-90334-U] p 264 N92-28635

Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods

[NLR-TP-89119-U] p 47 N92-28659

Hyperbolic grid generation control by panel methods

[NLR-TP-91061-U] p 264 N92-29604

HOUTMAN, E. M.

Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001

HOUIWINK, R.

Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils

[PB92-138569] p 206 N92-70561

HOWARD, G.

Operational aspects of spacecraft autonomy p 131 A92-24207

HOWLAND, CHRIS

The role of crack growth in defect assessment [PNR-90798] p 220 N92-20909

HRECZYCHO, JERZY

Error analysis of the COSPAS SIRSAT system p 129 A92-21288

HUANG, G.-P.

Model and computation of discrete jets in crossflow p 165 A92-21505

HUANG, L.

Noise-driven flow p 10 A92-18680

HUBER, H.

The Eurofar program - An European overview on advanced VTOL civil transportation system

[MBB-UD-0611-91-PUB] p 58 N92-30418

HUBERSON, SERGE

Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466

HUCHLER, M.

Application of CFD tools in space projects p 197 N92-25897

HUDSON, MAURICE G.

Airport technology international 1992 p 111 A92-39514

- HUERTH, M.**
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- HUFFLEN, JEAN-MICHEL**
Formal specification of satellite telemetry: A practical experience p 129 N92-12456
- HUGHES, NICHOLAS**
Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550
- HUGHES, THOMAS J. R.**
Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 N92-24963
- HUGHSON, R. L.**
Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547
- HULEK, TOMAS**
Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
- MULTQVIST, BENGT**
The need of coordinated observations in space and from ground p 233 N92-26310
- HUMER, K.**
Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
- HUMMEL, D.**
Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- HUMPHREYS, R. G.**
High temperature superconducting vortex flow transistor p 159 A92-38971
- HUNNEMAN, ROGER**
Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108
- HUNT, J. C. R.**
Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
- HUNT, JAMES J.**
Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668
Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
- HUNTSMAN, I.**
The design and testing of a radial flow turbine for aerodynamic research [ASME PAPER 91-GT-220] p 93 A92-15636
- HUOMO, H.**
CAPS-plasma spectrometer for the Cassini spacecraft p 140 N92-10565
- HUOT, J.-P.**
Fast finite element solvers for reentry flows p 35 N92-14988
- HUOVELIN, J.**
The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma p 140 N92-10563
- HURLEY, K.**
The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 N92-27049
- HURRASS, KARLHEINZ**
Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600
Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601
- HUTHER, M.**
State of composite material structure control in situ p 215 A92-54862
- HUTIN, P. M.**
Unsteady wind tunnel tests p 109 N92-34166
- HUTTENBACH, R. C.**
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- HUYNH, H. T.**
Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
- HYDE, R. A.**
VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561
Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094
- IACOVIDES, H.**
Computational modelling of turbulent flow in S-bends p 199 N92-27480
- IANNONE, M.**
Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- ICKE, V.**
The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171
- IEEMMA, U.**
A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- IEROTHEOU, C. S.**
A fire field model implemented in a parallel computing environment p 166 A92-23252
- IGARASHI, S.**
Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- IJJAS, G.**
Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
- IKRAM, S.**
Cardiological aspects of pilot's fitness to fly p 245 A92-16406
- ILBAS, D.**
Experimental and theoretical studies on helicopter rotor fuselage interaction [ONERA, TP NO. 1991-197] p 13 A92-26356
Theoretical and experimental studies of helicopter rotor/fuselage interaction [ONERA, TP NO. 1991-198] p 13 A92-26357
- ILIEV, O. P.**
An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- IMBERT, BEATRICE**
Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- IMMICH, H.**
Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
- INFELD, D.**
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- ING, D. N.**
The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
- IONTA, P.**
Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- IOORDANOV, D. V.**
Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
- IRVINE, DAVID**
The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257
- ISAKA, H.**
Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354
- ISLAM, M. Q.**
Secondary flow investigation inside the passage of a compressor cascade p 19 A92-42124
- ISMAIL, I. H.**
A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines [ASME PAPER 91-GT-392] p 162 A92-15722
- ITTEN, K. I.**
Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- IVANOV, I. B.**
A method for determining the potential of a spacecraft p 131 A92-23433
- IVERSEN, IVER B.**
Balloons for conjugate cusp studies in the 1990's p 233 N92-26315
- IVLEV, B. I.**
Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors [PB92-142421] p 273 N92-22738
- JACK, C. D.**
The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 N92-21847
- JACOBS, C. M. J.**
The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345
- JACOBS, J. M. J. W.**
Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000
Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds [NLR-TP-90029-U] p 41 N92-20498
Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657
Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow [PB92-138718] p 53 N92-70577
- JACQUET, B.**
Study of noise generated by the impingement of a hot supersonic jet on an obstacle [ONERA, TP NO. 1992-33] p 267 A92-48594
- JACQUOTTE, O.-P.**
Detailed analysis of wing-nacelle interaction for commercial transport aircraft [ONERA, TP NO. 1991-152] p 9 A92-16122
- JACQUOTTE, OLIVIER-PIERRE**
Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics [ONERA, TP NO. 1992-30] p 171 A92-31488
Recent progress in inverse methods in France p 97 N92-13938
- JAGNISZCZAK, IGOR**
Error analysis of the COSPAS SARSAT system p 129 A92-21288
- JAKHIAN, GREGOIRE**
Security rights in aircraft under Belgian law p 280 A92-35589
- JAKOBSEN, JORGEN**
Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044
- JALLADE, S.**
Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
- JAMES, ALLAN R.**
Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969
- JAMES, C. D.**
Design aspects of the attitude control system for the SOHO spacecraft p 135 N92-24433
- JAMES, M.**
Pilot attitudes to cockpit automation p 250 A92-44926
- JANAK, ANTONIN**
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
- JANSEN, P.**
Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977
- JANSSEN, L. P. B. M.**
Marangoni convection in V-shaped containers p 172 A92-37932
- JANSSEN, M.**
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234
- JARDINE, M.**
A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574
- JEANDUPEUX, J. M.**
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630
- JECKO, B.**
Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678
- JEFFERIES, E. B.**
Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022
Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793
- JEFFERY, R. W.**
Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- JENKINS, IAN**
Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 N92-18632
- JENNINGS, NICHOLAS**
Aerospace software engineering in the United Kingdom p 255 A92-19405

JENTINK, H. W.

Potential applications of laser Doppler anemometry for in-flight measurements
[NLR-TP-90163-U] p 92 N92-28654

JESIONEK, KRZYSZTOF J.

Total losses in turbulent flows inside conical diffusers
p 23 A92-47782

JESSEE, E.

An aircraft manufacturer's perspective
p 2 A92-33430

JEWELL, C. I.

An overview of ESA cryocooler activities
p 154 N92-25850
Pre-qualification level testing of an 80 K Stirling cycle cooler
p 154 N92-25851
A heat switch for space cryocooler applications
p 160 N92-25852

JIMENEZ, JAVIER

A model for bursting of near wall vortical structures in boundary layers
p 174 A92-40156

JOCHUM, ANNE M.

Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex
p 234 A92-13336
Simple models for the description of turbulence in the atmospheric boundary layer
[DLR-FB-90-17] p 232 N92-19292

JOHANNESEN, J. A.

Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88
p 242 A92-34878

JOHANNESEN, JOHNNY A.

Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations
p 242 A92-34943

JOHANNESEN, OLA M.

Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations
p 242 A92-34943

JOHANNMEIER, D.

Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations
p 134 N92-23974

JOHANNMEIER, DIETER

Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes
p 38 N92-15031

JOHANSSON, B. C. V.

Well-posedness in the generalized sense for boundary layer suppressing boundary conditions
p 170 A92-31399
Well-posedness in the generalized sense for the incompressible Navier-Stokes equation
p 262 A92-37789

JOHANSSON, MELKER

Mechanical noise from large wind turbines - Experiences from Swedish prototypes
p 226 A92-39046

JOHNSON, CLAES

Adaptive streamline diffusion methods for compressible flow using conservation variables
p 172 A92-37535
Finite element methods for flow problems
p 200 N92-27672

JOHNSON, COLIN

Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming
p 226 A92-19193

JOHNSON, M. C.

Propulsion system performance and integration for high Mach air breathing flight
p 96 A92-46429

JOHNSTON, L. J.

Solution of the Reynolds-averaged Navier-Stokes equations for transonic aerofoil flows
p 6 A92-13198

JOHNSTON, LESLIE J.

Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions
[AIAA PAPER 92-2638] p 20 A92-45507
Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections
[AIAA PAPER 92-2653] p 21 A92-45569

JOHNSTONE, A. D.

The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415

JOHNSTONE, R. M.

Extended Ly Alpha emission around quasars at z of more than 3.6
p 247 A92-56703

JOLY, V.

Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies
p 188 N92-15029

JONASSON, HANS G.

Inter-noise 90: Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vols. 1 & 2
[ISBN 91-7848-224-0] p 266 A92-39042

JONES, D. C.

Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft
p 222 A92-35034

JONES, M.

The integration and test of modern spacecraft control systems
p 261 N92-20601

JONES, P. B.

Neutron superfluid spin-down and magnetic field decay in pulsars
p 283 A92-13865
Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation
p 284 A92-47146

JONES, R. L.

Homogeneous and heterogeneous chemistry along air parcel trajectories
p 232 N92-14541

JONES, T. V.

An Axial Turbopump
[ASME PAPER 91-GT-1] p 211 A92-15501
A comparison of numerical predictions and experiments on under-expanded jets
[AIAA PAPER 92-4027] p 141 A92-56849
Turbulent spot generation and growth rates in a transonic boundary layer
[AD-A250221] p 202 N92-29118

JORDAN, D. T.

Whole aircraft lightning indirect effects evaluation using low level injection techniques
p 68 A92-20134

JORGENSEN, OLE

Optimization of the flutter load by material orientation
p 217 A92-15222

JORNA, P. G. A. M.

Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532

JORNA, PETER G. A. M.

Heart rate variability as an index for pilot workload
p 246 A92-45012

JOSSO, P.

Aluminides modified by palladium - Protection of new parts by local finishing
[ONERA, TP NO. 1992-49] p 149 A92-48610

JOUAN, M.

State of composite material structure control in situ
p 215 A92-54862

JOUBERT, T.

Real-time mechanisms in a multibase knowledge system
p 264 A92-20345

JOUET, C.

Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations
[ONERA, TP NO. 1991-131] p 9 A92-16107
Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes
[ONERA, TP NO. 1991-237] p 13 A92-26387
Navier-Stokes computation over a three-dimensional ramp
[ONERA, TP NO. 1992-55] p 181 A92-48616

JOURDON, N.

Influence of microvibrations on spacecraft performances
p 134 N92-23825

JUBE, MICHEL

The European ATC challenge
p 58 A92-11877

JUDGE, T. R.

A laser light sheet investigation into transonic external aerodynamics
p 207 A92-45136
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade
[ASME PAPER 91-GT-221] p 179 A92-46825

JUILLEN, J. C.

The effects of wall suction on laminar-turbulent transition in three-dimensional flow
p 15 A92-36021

JULLIARD, J.

Experimental study of noise generation and propagation in a turbofan model
[ONERA, TP NO. 1992-199] p 268 A92-56169

JUSTE, G. L.

Gravitational effects on flame spreading over thin cylindrical fuel samples
p 147 A92-14020

JUVE, DANIEL

Pressure field developed by the random movement of the vortices near a wall
[ETN-92-91665] p 204 N92-32770

K**KAEMAEAEINEN, V.**

The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma
p 140 N92-10563

KAESTNER, MARTINA

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS
p 234 N92-26340

KAITALA, VEIJO

Aircraft control for take-off in windshear
p 104 A92-36990

KALDEICH, BRIGITTE

Launch Bases and Control Infrastructures for Spacecraft
[ESA-SP-342] p 125 N92-20715

KALDELLIS, J. K.

3-D loss prediction based on secondary flow and blade shear layer interaction
[ASME PAPER 91-GT-59] p 7 A92-15536
Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines
p 175 A92-40172

KALLENBACH, P. A.

Catalogue of ESA patents
[ESA-SP-1131-REV-1] p 287 N92-19411

KAMOUN, P.

ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft
p 285 N92-25679

KANG, SHUN

Three dimensional flow in a linear compressor cascade at design conditions
[ASME PAPER 91-GT-114] p 8 A92-15565

KAPPENBERGER, L.

Cardiological aspects of pilot's fitness to fly
p 245 A92-16406

KARADIMAS, GEORGES

The position of the unsteady flow computation in the compressor and turbine design and analysis process
[AIAA PAPER 92-0015] p 94 A92-22137

KARAGIANNIS, F.

Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity
[ASME PAPER 91-GT-168] p 8 A92-15603
Arbitrary blade section design based on viscous considerations - Background information
p 15 A92-36029

KAREMAKER, J. M.

Unsteady Euler calculations in 3D internal aerodynamics
p 199 N92-27470

Control of blood pressure in humans under microgravity
p 248 N92-23071

KASPER, M.

Specifying PA/safety design to requirements for the Columbus project and general conclusions
p 153 N92-18649

KASSIES, A.

Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement
[NLR-TP-90134-U] p 202 N92-28712

KATHEDER, K.

The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle
p 200 N92-27482

KATRAMATOS, D. T.

3-D loss prediction based on secondary flow and blade shear layer interaction
[ASME PAPER 91-GT-59] p 7 A92-15536

KAUROLA, JUSSI

Decomposing the atmospheric flow using potential vorticity framework
p 236 A92-21196

KAYA, KEMAL

Computer simulation of an unsteady flow around an airfoil with a spoiler
p 19 A92-43167

KAYA, M. O.

Numerical simulation of vortex street-edge interaction
p 33 N92-13027

KAYKAYOGLU, C. R.

Computer simulation of an unsteady flow around an airfoil with a spoiler
p 19 A92-43167
Numerical simulation of vortex street-edge interaction
p 33 N92-13027

KAYNAK, UNVER

Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil
[AIAA PAPER 92-0027] p 11 A92-22149

KEHAYAS, N.

ASTOV combat aircraft design synthesis and optimization
[CRANFIELD-AERO-9201] p 88 N92-31515

KEHR-CANDILLE, V.

Elasto-acoustic damped vibrations - Finite element and modal reduction methods
[ONERA, TP NO. 1992-52] p 218 A92-48613

KEIL, H.

Testing of an experimental photographic reconnaissance system
p 209 N92-25602

KELHA, V.

CAPS-plasma spectrometer for the Cassini spacecraft
p 140 N92-10565

- KELLER, JOHN**
Procurement doubts threaten research p 275 A92-47974
- US Navy revisits escape modules p 73 A92-47975
- KELLER, K.**
Winged launcher thermal design aspects p 127 N92-27013
- KELLIG, A.**
Balloon-borne drop capsule MIKROBA p 152 N92-24617
- KERBER, DIRK**
Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 N92-12156
- KERHERVE, YVES**
Rafale: Program update - Development of a naval version p 72 A92-40035
- KERRIDGE, D. J.**
Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
- KESKINEN, J.**
Low pressure impactor with electrical concentration detection p 209 N92-10534
- KHAN, T.**
Advanced superalloys for turbine blade and vane applications [ONERA, TP NO. 1992-2] p 149 A92-48578
- KIEMLE, CHRISTIAN**
Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- KILSBY, C. G.**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- KINDL, B.**
The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- KING-HELE, D. G.**
The upper atmosphere as sensed by satellite orbits p 230 A92-30638
- KING, J. E.**
Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
- KINGCOMBE, R. C.**
An Axial Turbopump [ASME PAPER 91-GT-1] p 211 A92-15501
- KIRKKOPRU, K.**
Secondary separation from a slender wing p 6 A92-13448
- KITCHEN, E. H.**
The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
- KLAPWIJK, T. M.**
Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897
- KLEIN, MICHEL**
On the analysis of liquid filled free-free tanks p 196 N92-23843
- KLEIN, P.**
The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves p 166 A92-23292
- KLEIN, RUPERT**
Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
- KLEINSCHMIDT, E.**
The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048
- KLEMBOWSKI, WIESLAW**
Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291
- KLETT, R.**
Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307
- KLOTZ, H.**
Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
- KLUG, J.**
Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774
- KLUWICK, A.**
Axisymmetric laminar interacting boundary layers p 176 A92-42534
- KNEZEVIC, J.**
Reliability modeling of the systems whose components have non-constant failure rate p 216 N92-18648
- KNITTEL, G.**
Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- KNOTT, M. J.**
Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950
- KNOTT, P. G.**
Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315
Some implications for advanced STOVL operation from invincible class ships p 82 N92-21971
- KNOWLES, K.**
Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446
Impinging jets in cross-flow p 169 A92-28942
Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549
- KOBLUSCHKA, M. R.**
Observation of inverse domains in high Tc superconductors p 273 A92-52211
- KOC, A.**
Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 N92-29713
- KOCH-PETERS, DOROTHEA**
Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000
- KOCH, URSULA**
New accelerated corrosion test methods [MBB-Z-0406-91-PUB] p 150 N92-32895
- KOEHLER, H.**
Requirements and possible technical solutions derived from the new airmobility concept of the German Army p 1 A92-14348
- KOELLE, D. E.**
Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
- KOENIG, KLAUS**
Short time force measurement system p 114 N92-15001
- KOENIG, R.**
ATTAS flight test and simulation results of the advanced gust management system LARS [AIAA PAPER 92-4343] p 106 A92-55332
- KOERNER, ROLAND**
Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926
- KOHR, R.**
On board planning of 4D-trajectories p 66 N92-27897
- KOKKE, J. M. M.**
Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
- KOLKMAN, H. J.**
Examination of aircraft warning and caution lights after shock testing [NLR-TP-89284-U] p 58 N92-30474
- KOMANN, WALTER**
Market directed thinking in a technological operation p 276 N92-23929
- KONDO, Y.**
Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 N92-21763
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788
- KONSTANTINOVA, IRINA**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- KOOI, J. W.**
Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
Comparison of LDA and LTA applications for propeller tests in wind tunnels [NLR-MP-88031-U] p 47 N92-28658
Selection of a laser anemometer technique for propeller tests in wind tunnels [PB92-138510] p 118 N92-70563
- KOOMEN, P.**
First results from the Netherlands SAR testbed 'PHARS' p 221 A92-34903
- KOPAL, VLADIMIR**
Issues involved in defining outer space, space object and space debris p 282 A92-51856
- KOPPIN, N. B.**
Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
Superfluid vortex nucleation in He-3 flow p 271 N92-10479
Dynamics of vortices in high-temperature superconductors p 273 N92-10501
Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors [PB92-142421] p 273 N92-22738
Mutual friction in superfluid He-3: Effects of bound states in the vortex core [PB92-142231] p 197 N92-26507
- KOPPENWALLNER, G.**
Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 N92-23974
- KOPPENWALLNER, GEORG**
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
- KORDULLA, W.**
Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 N92-12998
- KOREN, B.**
Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989
- KOREN, BARRY**
Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822
- KORHONEN, J. S.**
Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 N92-21763
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788
- KORTING, P. A. O. G.**
Spin-offs of the solid fuel combustion chamber project p 143 N92-22275
- KOSCHEL, W.**
Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302
Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479
- KOSTICH, S. T.**
The multiparameter method of a boundary layer on thin bodies of revolution p 165 A92-21613
- KOSTOV, K. G.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- KOTOVSKAIA, A. R.**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- KOURTA, A.**
Performance of turbulence models to predict supersonic boundary layer flows p 16 N92-37553
- KOUTMOS, P.**
Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
- KOWALEWSKI, T. A.**
Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
- KOZAROV, M.**
Linear panel flutter of an elliptic cylindrical shell p 218 A92-21216
- KOZEL, KAREL**
Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
- KRAMER, P.-A.**
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
- KRAMER, J.**
First approach to an integrated fin design p 83 N92-23236
Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 N92-28471
Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650
- KRAUS, W.**
X-31: Discussion of steady state and rotary derivatives p 81 N92-18789

KRAUS, WERNER

Aerodynamic development of the X-31 aircraft for the high angle of attack region
[MBB-FE211-S-PUB-452] p 77 N92-17313

KREIS, ANDREAS

On the analysis of liquid filled free-free tanks
p 196 N92-23843

KRETZSCHMAR, K.

Balloon-borne drop capsule MIKROBA
p 152 N92-24617

KRICHBAUMER, W.

Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106

KRICKE, DIETER

Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547

KRIEBEL, KARL-THEODOR

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

KRIJN, ROBERT

Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928

KROLL, N.

Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987

KRONMUELLER, H.

Observation of inverse domains in high Tc superconductors p 273 A92-52211

KRUCH, S.

Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles
[ONERA, TP NO. 1992-31] p 218 A92-48592

KRUTHOF, G. H.

Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897

KRUSIUS, M.

Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476

Vortex motion in rotating superfluid He-3-B
[PB92-134162] p 194 N92-21763

Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
[PB92-134170] p 195 N92-22788

KUBE, ROLAND

BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344

KUBRYNSKI, K.

Two-point optimization of complete three-dimensional airplane configuration
[AIAA PAPER 92-2618] p 73 A92-45491

KUBRYNSKI, KRZYSZTOF

Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948

KUCZERA, HERIBERT

The German Hypersonics Technology Programme - Status report 1992
[IAF PAPER 92-0867] p 127 A92-57258

KUDELA, H.

Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658

KUEBLER, W. R.

Balloon-borne drop capsule MIKROBA p 152 N92-24617

KUERTEN, J. G. M.

Improved shock-capturing of Jameson's scheme for the Euler equations
[PB92-148758] p 196 N92-23251

A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence
[MEMO-1009] p 202 N92-29972

KUL, H. R.

3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061

KULISA, P.

Model and computation of discrete jets in crossflow p 165 A92-21505

KULLBERG, GUNNAR

Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779

KURU, SELAHATTIN

The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180

KURZ, RAINER

Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades
[ETN-92-92056] p 205 N92-33910

KURZIUS, S. C.

The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

KURZKE, J.

Calculation of installation effects within performance computer programs p 102 N92-28465

KUSCER, IVAN

Entropy production in gaseous boundary layers p 183 A92-52814

KUYVENHOVEN, J. L.

Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 N92-24411

The 3-D Euler flows around modern airplanes
[PB92-138759] p 52 N92-70540

KYNAERAEINEN, J. M.

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3
[PB92-134147] p 269 N92-21773

L

LA HOZ, CESAR

Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800

LABITZKE, K.

A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659

LABORIE, MARTINE

ALICO: An aid system for designing bonded joints
[REPT-911-430-134] p 152 N92-12146

LABOURDETTE, ROGER

Survey of French activities concerning structural airworthiness and aging aircraft p 57 N92-30130

LABRUJERE, T. E.

Evaluation of measured-boundary-condition methods for 3D subsonic wall interference
[NLR-TR-88072-U] p 49 N92-29884

Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions
[PB92-138577] p 118 N92-70574

LABRUJERE, TH. E.

Review of aerodynamic design in the Netherlands p 76 N92-13929

LABURTHE, F.

Boundary layer transition
[CERT-RTS-55/5018-45] p 186 N92-12210

LACAS, F.

The coherent flamelet model for propulsion applications p 147 N92-27486

LACHLAN-COPE, T. A.

A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489

LACOMBE, A.

Large thin composite thermostructural parts p 134 N92-23821

LACOR, C.

A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026

An integrated CFD system for 3D turbomachinery applications p 101 N92-27464

LACROIX, J. P.

Mixed approach towards modular avionics conflicting requirements p 91 N92-14051

LADDA, V.

The Operational Loads Monitoring System, OLMS p 79 N92-18586

LADEN, T.

Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry
[REPT-90/55] p 187 N92-12216

LAFON, A.

On the numerical treatment of nonlinear source terms in reaction-convection equations
[AIAA PAPER 92-0419] p 168 A92-26269

The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814

LAFON, J.

Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle
[MBB/FE202/S/PUB/461] p 5 N92-30232

LAFON, P.

High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel
[ONERA, TP NO. 1991-124] p 9 A92-16102

LAGO, V.

Rotational temperature measurements in an arc jet p 177 A92-44395

Rotational temperature measurements of N2(+) in an arc jet at low pressure
[AIAA PAPER 92-2967] p 273 A92-46982

LAGREE, PIERRE-YVES

Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework. II p 6 A92-13815

LAHTINEN, JOUKO

Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] p 147 N92-14141

LALANDA, PH.

Real-time mechanisms in a multibase knowledge system p 264 A92-20345

LALLEMAND, MARIE-HELENE

Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157

LAM, F.

A theoretical investigation of the induced drag of wing of finite aspect ratio
[CUED/A-AERO/TR-17(1991)] p 43 N92-22193

LAMERIS, J.

The use of load enhancement factors in the certification of composite aircraft structures
[NLR-TP-90068-U] p 86 N92-28649

LAMPART, P.

A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068

LANCIA, M. R.

A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504

A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005

LANCIOTTI, A.

Effects of spectrum variations on fatigue crack growth p 219 A92-57399

The G-222 aircraft individual tracking programme p 78 N92-18582

LANGE, H.-H.

The role of systems simulation for the development and qualification of ATTAS p 117 N92-28548

LANGELUEDECKE, ECKART

The engagement of German space industry in national and European environmental space programmes p 229 N92-25242

LANGER, H. J.

Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350

LANGER, H.-J.

LAH main rotor model test at the DNW p 70 A92-35771

LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687

LANGLEY, R. S.

A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866

LANTOS, PIERRE

The sun, the solar wind, and cosmic rays p 285 A92-27131

LANZA, A.

Vortices on accretion disks p 284 A92-27396

LARCHEVEQUE, MICHELE

Formation and stability of a semi-infinite vorticity line under an adhesion condition
[ETN-92-91075] p 193 N92-20230

LARIGALDIE, S.

Mechanisms of high-current pulses in lightning and long-spark stepped leaders
[ONERA, TP NO. 1992-202] p 159 A92-54678

LARINI, M.

A numerical simulation of injection of droplets in a compressible flow
[AIAA PAPER 92-2929] p 180 A92-47899

LAROCCA, FRANCESCO

Research on inverse methods and optimization in Italy p 97 N92-13956

LAROUCHE, P.

Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080

LARROQUE, PIERRE

The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544

LARROUTOUROU, B.

Recent progress in reactive flow computations p 167 A92-26220

LARSEN, PETER N.

Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956

LARSONNEUR, R.

Control concepts for active magnetic bearings p 214 N92-27743

- LARTER, NICK**
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- LARUELLE, GERARD**
Potential hypersonic vehicles applications [AIAA PAPER 91-5086] p 1 A92-17854
- LASGORCEIX, P.**
Rotational temperature measurements in an arc jet p 177 A92-44395
Rotational temperature measurements of N₂(+) in an arc jet at low pressure [AIAA PAPER 92-2967] p 273 A92-46982
- LAST, DAVID**
Accurate current measurement using drogued buoys employing Decca Navigator and Argos p 241 A92-12278
- LAST, STEVE**
British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023
- LAUMONIER, J.**
Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
- LAUNDER, B. E.**
Computation of impinging flows using second-moment closures p 173 A92-40083
Progress and paradoxes in modelling near-wall turbulence p 174 A92-40158
Towards the computation of turbulent hypersonic flows [AERO-REPT-9106] p 40 N92-18318
Computational modelling of turbulent flow in S-bends p 199 N92-27480
- LAUNDER, BRIAN E.**
Turbulence modelling in CFD: Present status, future prospects p 197 N92-24515
- LAURE, S.**
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
- LAUTIER, ELISABETH**
AGILE: An expert system for large space project management p 276 N92-20621
- LAVALLEE, D.**
Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461
- LAVALLEE, DANIEL**
Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
- LAVENTU, FRANCOIS**
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- LAVROFF, OLEG**
How to circulate official terminology [IAF PAPER 92-0346] p 277 A92-55761
- LAWTON, B. W.**
Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241
- LAZAREFF, M.**
Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface p 263 A92-54574
- LAZZERI, L.**
Effects of spectrum variations on fatigue crack growth p 219 A92-57399
The G-222 aircraft individual tracking programme p 78 N92-18582
- LE BALLEUR, J. C.**
Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method [ONERA, TP NO. 1992-1] p 23 A92-48577
- LE GALL, JEAN-PIERRE**
Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
- LE MENEC, J.-C.**
Real-time mechanisms in a multibase knowledge system p 264 A92-20345
- LE, T. H.**
Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163
Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164
Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 N92-13018
- LEBALLEUR, J. C.**
Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration [ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- LEBLANC, R.**
Control aspects of the transition from transversal to transonic flow, step effects [ETN-91-90106] p 29 N92-11981
- Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215
- LEBOEUF, F.**
Model and computation of discrete jets in crossflow p 165 A92-21505
- LEBOUAR, PHILIPPE**
Normalization, reliability and validation of information for spatial operations p 157 N92-15285
- LEBOULBAR, M.**
Concurrent engineering p 260 N92-30952
- LEBRET, Y.**
Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
- LEBRET, YANN**
Marco contract report [ETN-92-91077] p 193 N92-20232
- LECA, P.**
Status and user characterization of parallel machines for digital simulation p 260 A92-23046
- LECCE, LEONARDO V.**
Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- LECLERCQ, M. C.**
Industrial practice in aeronautical maintenance p 3 A92-47774
- LECOINTE, YVES**
Interactive visualization of CFD results ASCETE p 190 N92-16235
- LECOMTE, CLAUDE**
The sonic boom and problems related to supersonic flights of military aircraft [ONERA, TP NO. 1991-162] p 9 A92-16129
- LECOMTE, P.**
Aircraft simulations of the POLDER experiment: First results p 223 N92-11471
- LECURU, D.**
Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- LEE, R. J.**
Joining of composite materials to metals p 211 A92-10695
- LEE, R. N.**
Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- LEE, SANGSAN**
A subgrid-scale model based on the second-order velocity structure function p 203 N92-30651
- LEESE, M. R.**
Low cost spacecraft attitude sensors p 140 N92-24458
- LEFAS, C. C.**
Computation of aircraft geometric height under radar surveillance p 61 A92-40239
- LEFFERTS, A. N.**
NATO CCMS aircraft noise study on receiver technology p 226 A92-39050
Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- LEGENDE, R.**
Topology of steady flows of low viscosity fluids p 162 A92-11219
- LEGENNE, JEROME**
Hermes-space station phasing strategies optimization [IAF PAPER 91-345] p 130 A92-14751
- LEGGE, H.**
Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- LEGRAFF, J. E.**
Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118
- LEGUILLOUX, Y.**
Approach and landing assisted by onboard image processing p 64 A92-21959
- LEHNAFF, A.**
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630
- LEHTIMAEKI, R.**
TRANSF: A 3-D grid generator based on transfinite interpolation [PB92-151919] p 259 N92-25519
- LEITMANN, GEORGE**
Aircraft control for take-off in windshear p 104 A92-36990
- LEJEUNE, DAMIEN**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- LEMARIE, D.**
Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
- LEMEUR, ALAIN**
Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469
- LEMMER, L.**
Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBS-FE2-PUB-S-450] p 78 N92-18333
- LEMMIN, U.**
On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
- LEMOINE, MICHEL**
Formal specification of satellite telemetry: A practical experience p 129 N92-12456
- LEMOING, T.**
Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- LEMPEREUR, C.**
Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020
- LENGRAND, J. C.**
Numerical and experimental investigation of rarefied compression corner flow [AIAA PAPER 92-2900] p 23 A92-47876
Compression ramp in rarefied gas [RC-90-08] p 29 N92-11978
Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 N92-11979
Flat plates placed in depleted hypersonic flow [SESSIA-430/91.960] p 50 N92-31508
- LENTINI, D.**
Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- LENZE, BERNHARD**
Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
- LEOMY, F.**
Dispersion curves analysis for bonded plates at low Fd p 217 A92-13540
- LEONARD, O.**
Blade design and analysis using a modified Euler solver p 97 N92-13952
- LEONCINI, PAOLO**
FLOVIS (FLOW Visualizer) user manual, release 2.6, September 1990 p 190 N92-16238
- LEONE, G.**
High enthalpy nozzle flows p 36 N92-15000
- LEOUTSAKOS, G.**
Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- LEPAPE, MARIE-CLAIRE**
Recent progress in inverse methods in France p 97 N92-13938
- LEPART, M.**
Aircraft ground vibration test by means of flight control surfaces [ONERA, TP NO. 1991-96] p 103 A92-16079
- LEPART, MARC**
Dynamic characterization and identification of nonlinear systems application to aeronautical structures p 217 A92-11830
- LEPECHON, J. C.**
ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
- LEPPARD, C. J.**
Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892
- LERCH, MANFRED**
A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741
- LESAIN, ALAIN**
Numerical flow visualization of high Reynolds number recirculated flows using an animation technique [ONERA, TP NO. 1991-215] p 168 A92-26367
- LESIEUR, M.**
Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
Numerical simulation of turbulence at the back of the airplane [ETN-92-91664] p 51 N92-32769
- LESIEUR, MARCEL**
Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
- LESTEL, J. C.**
Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 N92-15004

LESTER, M.

Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271

LESUEUR, C.

Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197

LESUEUR, PATRICK

AGILE: An expert system for large space project management p 276 N92-20621

LETALLE, P.

The Hermes search and rescue operations in the open sea [AIAA PAPER 91-4099] p 128 A92-24357

LEUCHTER, O.

Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604

LEVALLAIS, J. M.

Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

LEVINS, DERMOT

Protection concepts used in spacecraft power systems p 142 N92-13176

LEVOLD, J.

International collaboration in PA and safety, the Eurospace PA-Panel p 215 N92-18608

LEWANDOWSKI, JANUSZ

Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791

LEWIS, G. M.

The evolution of the bypass engine [PNR-90832] p 99 N92-21850

LEWY, S.

Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353

Experimental study of the effects of atmospheric turbulence on sound propagation over the ground [ONERA, TP NO. 1991-211] p 266 A92-26363

Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169

LEX, CLAUDIA

Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber) [MBB-UK-0144-PUB] p 142 N92-18636

LEYLAND, P.

Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038

LEYNAERT, J.

Recent development of wind-tunnel test techniques at ONERA [ONERA, TP NO. 1991-135] p 110 A92-16110

Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel [ONERA, TP NO. 1991-219] p 111 A92-26371

LI, JING

Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347

LI, SHUANHU

Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372

LI, Y.

Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967

LI, ZHAO-LIANG

Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124

LIANDRAT, J.

Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128

LIASJO, K. H.

Advanced method for single event aircraft noise analysis p 266 A92-39060

LIASJO, KARE H.

Computation of aircraft noise exposure using digitized topography data p 227 A92-39058

LIBERATI, F.

Innovation in the laser warning sensor field p 89 A92-35742

LIE, IVAR

Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386

LIEBAERT, PH.

G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984

Circulatory biomechanics effects of accelerations p 248 N92-18991

LIEBE, DETLEF

Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382

LIGHART, L. P.

Quantitative estimation of secondary surveillance radar information p 59 A92-24943

LILLEY, G. M.

Jet noise classical theory and experiments p 268 N92-10602

LIMAT, L.

Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461

LIMBOURG, M. C.

USO concept in the member states - Belgium p 119 A92-32466

The USOCs, the resources management, and their links with telepresence p 276 N92-33466

LINAN, AMABLE

Asymptotic techniques for the analysis of fluid systems p 163 A92-16229

LINDBLAD, I.

A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026

LINDEMANN, ULRICH

Project of an adaptive multiaxial autopilot with learning pilot control [ETN-92-90592] p 107 N92-15072

LINDEN, J.

A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617

LINDER, D. R.

The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415

LINDHOLM, ARNE

JAS 39 Gripen progress report p 67 A92-16058

JAS 39 Gripen flight test report p 72 A92-40030

LINDHOUT, J. P. F.

VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323

LINDSAY, G.

Dynamic solder management [AD-A250564] p 150 N92-29647

LIOU, MENG-SING

Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523

LIU, A.

Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337

LIU, Y. L.

The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083

LIU, YANSON

Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868

LJUNGGREN, STEN

Mechanical noise from large wind turbines - Experiences from Swedish prototypes p 226 A92-39046

LLEWELYN-DAVIES, D. I. T. P.

An investigation into the interface between three closely spaced axis-symmetric bodies at subsonic speed [CRANFIELD-AERO-9114] p 50 N92-31514

LLORENTE-MARTINEZ, J. S.

Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478

LLOYD, A. R. J. M.

Using Rankine vortices to model flow around a body of revolution p 169 A92-28061

LLOYD, C. R.

Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198

LOCATELLI, J.

Structural optimization at Aerospaziale Aircraft [AIAA PAPER 92-2371] p 256 A92-34542

LOCKOWANDT, CHRISTIAN

Swedish user support for Columbus p 120 A92-32469

LOCKWOOD, MIKE

Requirements for coordinated Cluster and ground-based observations of the cusp p 233 N92-26318

LOEFFGREN, PEJE

Aeroacoustics in inhomogeneous flow field [FFA-TN-1991-30] p 268 N92-12601

LOETZERICH, K.

Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370

LOEVE, W.

CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 N92-32835

LOISY, JEAN

Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461

LONG, JOHN B.

A conceptualization of aviation psychology on the civil flight deck p 250 A92-13849

LONGDON, NORMAN

Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961

LONGLEY, J. P.

Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464

LONGBARDI, R.

EH 101 ship interface trials: Flight test programme and preliminary results p 82 N92-21964

LONGSTAFF, R. W.

The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852

LONSDALE, GUY

Parallel and vector aspects of a multigrid Navier-Stokes solver [PB91-232868] p 260 N92-16645

LONSINGER, H.

Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 N92-18333

LOOYEN, W. J.

Aircraft experiments with visible and infrared sensors p 206 A92-37159

CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 N92-29707

LORAUD, J. C.

A numerical simulation of injection of droplets in a compressible flow [AIAA PAPER 92-2929] p 180 A92-47899

LORD, R. G.

Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261

LORDON, J.

A new automatic grid generation environment for CFD applications [AIAA PAPER 92-2720] p 21 A92-45558

LORENZO, F.

Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926

LORIA, A.

Columbus user support organization concept in Italy p 119 A92-32465

LORIER, PHILIPPE

Space software is first of all software p 258 N92-20590

LOTH, C.

Single alexandrite laser source for airborne DIAL system p 210 A92-51228

LOUAAS, E.

Dynamic load cases on Ariane 5 p 127 N92-23797

LOUISY, F.

Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180

LOUKIS, E.

Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624

A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661

LOVEJOY, S.

Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461

LOVEJOY, SHAUN

Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200

LOVELL, D. A.

An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023

LOVESEY, E. J.

Integrating machine intelligence into the cockpit to aid the pilot p 252 N92-12533

LOVETT, NIGEL P. J.

Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions p 252 N92-18999

LOWE, D. A.

How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607

LOWES, R. K.

Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 N92-24504

- LOWSON, M. V.**
The evaluation of canard couplings at high angles of attack
[AIAA PAPER 92-0281] p 12 A92-25735
Progress towards quieter civil helicopters p 267 A92-52847
- LUBRINA, P.**
Aircraft ground vibration test by means of flight control surfaces
[ONERA, TP NO. 1991-96] p 103 A92-16079
- LUCAS, RAFAEL**
Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
- LUCHINI, P.**
Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
- LUCIANI, BERNARD**
The French space programme p 121 A92-53458
- LUCIGNANO, FRANCESCO**
FLOVIS (FLOw VISualizer) user manual, release 2.6, September 1990 p 190 N92-16238
- LUCJANEK, WIESLAW**
General model of isolated helicopter blade for stability investigation p 71 A92-35774
Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
Simulation of helicopter see-saw rotor motion p 74 A92-56287
- LUDESCHER, B.**
Observation of inverse domains in high Tc superconductors p 273 A92-52211
- LUK'IANIUK, V. IU.**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- LUKOWICZ, HENRYK**
Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
- LUNDIN, R.**
Signatures of transient boundary layer processes observed with Viking p 230 A92-24532
- LUNNON, R. W.**
How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607
- LUU, T. S.**
The turbomachine blading design using S2-S1 approach p 97 N92-13940
- LYON, I. C.**
Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284
- M**
- MAARSINGH, T. A.**
Evaluation of measured-boundary-condition methods for 3D subsonic wall interference
[NLR-TR-88072-U] p 49 N92-29884
- MABEY, D. G.**
A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345
Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240
Effect of model cooling on periodic transonic flow p 22 A92-46900
A review of scale effects in unsteady aerodynamics p 24 A92-50121
Review of aircraft dynamic loads due to flow separation p 31 N92-13008
A review of scale effects on surfaces in unsteady motion p 46 N92-27962
- MACIEJNY, A.**
Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- MACINA, O.**
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
- MACKNIGHT, NIGEL**
NASA's quiet side. I p 3 A92-37875
- MACMILLAN, A. J. F.**
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000
- MADDALENA, D.**
In-orbit experiment of object capture technology
[IAF PAPER 91-002] p 251 A92-12427
- MAGNAUDET, J.**
A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
- MAGNI, GABRIO**
Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
- MAGNI, JEAN-FRANCOIS**
Double loop control law strategy and applications to helicopter
[CERT-2/7724-DERA] p 108 N92-19295
- MAGRE, P.**
CARS temperature measurements and validation of a computing code on a gas-turbine combustor
[ONERA, TP NO. 1991-224] p 94 A92-26376
- MAIER, THOMAS H.**
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
- MAININI, M.**
Test Engineering Language for Avionic Systems p 89 A92-35763
- MAIR, W. A.**
Aircraft performance
[ISBN 0-521-36264-4] p 69 A92-33919
- MAIRE, R.**
Cardiological aspects of pilot's fitness to fly p 245 A92-16406
- MAJDA, ANDREW J.**
Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
- MAJID, A. A.**
Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134
- MAJKA, KRZYSZTOF**
Blade defect force investigation in a compressor cascade p 6 A92-13233
- MAKAROV, M. M.**
An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- MALBEQUI, P.**
Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France)
[ONERA-RT-16/3641-PY] p 269 N92-20387
- MALE, J. M.**
Adaptive spectral methods with application to mixing layer computations p 182 A92-52404
- MALGUZZI, PIERO**
Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
- MALHERBE, C.**
Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080
- MALIK, N. A.**
Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
- MALOSTI, TIZIANO**
A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
- MANCINI, M.**
Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
- MANDERS, P. J. H. M.**
Application of VME-technology on an airborne data link processor unit
[NLR-MP-88040-U] p 66 N92-29615
- MANGOLD, PETER**
Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- MANIE, F.**
Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary
[ONERA-RTS-21/4365-AY-056A] p 76 N92-11009
- MANIE, SERGE**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- MANN, D. L.**
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems
[PNR-90839] p 98 N92-20573
- MANNINEN, A. J.**
Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256] p 265 N92-23665
- MANOHA, ERIC**
Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method
[ONERA, TP NO. 1991-212] p 13 A92-26364
- MANOLAKIS, D. E.**
Computation of aircraft geometric height under radar surveillance p 61 A92-40239
- MANSEL, W.**
Expert system for the Tornado ground-based check-out system p 91 N92-12536
- MANZO, F.**
Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
- MARANGOS, J.**
Expert system for the Tornado ground-based check-out system p 91 N92-12536
- MARCHANT, M. J.**
Mesh adaptivity with the quadtree method p 22 A92-47041
Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- MARCHIONNI, M.**
High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- MARCILLAT, J.**
Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
- MARCK, JEAN-ALAIN**
A 1D exact treatment of shock waves within spectral methods in plane geometry p 164 A92-17432
- MARCUS, LENNART**
Esrangle: Sounding rocket and balloon facility p 126 N92-20720
- MAREC, J.-P.**
Eighty years of aerospace technique through ATMA bulletins
[ETN-91-90097] p 286 N92-11963
- MAREC, JEAN-PIERRE**
Trends in commercial aircraft design - What evolution factors and what approach?
[ONERA, TP NO. 1992-25] p 4 A92-48587
- MARGUERIN, B.**
Criticality management in space programs p 275 N92-18619
- MARGUET, ROGER**
Generalities on the ramjet p 95 A92-41819
- MARIANI, G. P.**
Test Engineering Language for Avionic Systems p 89 A92-35763
- MARINI, M.**
Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- MARKHAM, K. C.**
Time-to-go estimation from infrared images p 61 A92-48308
- MARKIEWICZ, JANUSZ**
Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
- MARKIEWICZ, R. H.**
A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701
- MARMIGNON, C.**
Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 N92-15029
- MAROTTE, HENRI**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
- MARRAFFA, L.**
SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999
- MARRISON, CLAIRE**
The long-term psychological consequences of a major aircraft accident p 249 A92-13020
The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998
- MARSHALL, A. N.**
A history of the scientific study of living organisms in space
[IAF PAPER ST-92-0022] p 254 A92-57366
- MARSILIO, ROBERTO**
Nonequilibrium 3D flows of air through inlets p 200 N92-27487
- MARTIN, C.**
Electronically steerable antenna for aircraft p 156 N92-15272
- MARTIN, J. R.**
Fuzzy guidance system evaluation p 259 N92-27903
- MARTIN, J. S.-T.**
Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- MARTIN, T. W.**
Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892

MARTIN, VINCENT

Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956

MARTIN, W.

System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624

MARTINET, T.

Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529

MARTINEZ-VAL, RODRIGO

Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806

MARTIS, D.

Organized structures in the developing region of axisymmetric jet flow p 182 A92-51892

MARYNIAK, JERZY

Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft p 105 A92-47784

MARZANO, A.

Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 N92-14980

MARZARI, F.

Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398

MASILGE, CHRISTIAN

Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993

MASON, J. M.

Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086

MASON, P. J.

Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054

MASSAGUER, J. M.

Convection-induced shears for general planforms p 177 A92-44352

MASSARDO, A.

Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454

MASSON, A.

New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600

MASTRODDI, F.

A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942

MATHE, J. M.

Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020

MATHIEU, J.

Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604

MATHIOUDAKIS, K.

Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624

A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661

Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889

MATHUR, J. S.

The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515

MATIUKHIN, D. G.

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

MATSSON, O. J. E.

Transition to turbulence in curved channel flow p 18 A92-40125

MAURER, F.

Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994

MAX, HEINZ

Air transport research in Germany p 1 A92-17095
Air transport research in Germany p 1 A92-21014

MAZAUDIER, C.

Sodar wind speed profiles over forested boundary layer during the Hapex-Mobihy campaign p 235 A92-17729

MAZZUCHELLI, C.

The achievement of aerodynamic goals on the EH101 project through the 'single site' concept p 75 A92-56342

MBA, M. N.

The computation and validation of hovering rotor performance p 74 A92-56285

MCCALLUM, A. T.

A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334

MCCLELLAND, I. W.

Tomorrow's cockpit displays p 88 A92-13699

MCCLUMPHA, A.

Pilot attitudes to cockpit automation p 250 A92-44926

MCCLUSKEY, F.

Three-dimensional separated flows p 173 A92-40088

MCGRANE, KEVIN

Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299

MCGUIRK, J.

Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318

MCGUIRK, J. J.

Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102
The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676

MCINNES, GORDON

Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193

MCIVER, DUNCAN E.

Validation of flight critical control systems [AGARD-AR-274] p 108 N92-20026
Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 N92-32229

MCKENNA, D. L.

Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541

MCKENNA, P. M.

The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136

MCKENZIE, S. G.

High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 N92-20911

MCLAUGHLIN, RICHARD M.

Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971

MEE, D. J.

Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771

MEE, V. A.

Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 N92-27888

MEERKOTTER, R.

A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

MEERKOTTER, RALF

Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

MEERWIJK, L.

Real-time helicopter simulation using the blade element method p 264 A92-56278

MEGE, P.

Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 N92-10163

Numerical simulation of vortex breakdown via 3-D Euler equations p 185 N92-10164

MEGE, PH.

Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 N92-13018

MEGIE, G.

Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306

MEHNERT, A.

Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326

MEHU, BRUNO

Space software is first of all software p 258 N92-20590

MEIJER, J. J.

Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 N92-20475

Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958

NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750

MEIJER, JOS J.

Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369

MEILE, W.

Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055

MEISCHNER, PETER

Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342

MEIZOSO, J. C.

ARINC and commercial aircraft avionics. I p 60 A92-25655
ARINC and the avionics of commercial aircraft. II p 60 A92-37072

MELAAEN, M. C.

Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703

MELANDSO, FRANK

Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800

MENEVEAU, C.

Continuous wavelet analysis of coherent structures p 203 N92-30673

MENNE, S.

Efficient solution of three-dimensional viscous hypersonic flows p 37 N92-15007
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703

MENTASTI, A.

Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782

MENU, JEAN-PIERRE

Does the future lie in binocular helmet display? p 253 N92-19019

MENZEL, A.

An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655

MENZIES, K. R.

Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

MERCER, B. P.

Technology exploitation for in-service support of future rotorcraft p 4 A92-56327

MERCIER, N.

Dispersion curves analysis for bonded plates at low F_d p 217 A92-13540

MERCIER, V.

Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215

MERCURIO, U.

CFRP stiffened panels under compression p 146 N92-33044

MERET, G.

Industrial practice in aeronautical maintenance p 3 A92-47774

MERGEAY, M.

Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977

MERIENNE, M. C.

Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728] p 48 N92-28789

MERLO, A.

Numerical simulations around models in hypersonic wind tunnels p 36 N92-14998

MERTENS, JOSEF

Short time force measurement system p 114 N92-15001

MERX, M.

Expert system for the Tornado ground-based check-out system p 91 N92-12536

MERZKIRCH, W.

Interaction between shock wave and tubular flow p 197 N92-24392

MESEGUER, J.

A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124

- MESSERSCHMID, E. W.**
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles
p 114 N92-15009
- MESTRE, J. P.**
Radar-optronic tracking experiment for short and medium range aerial combat
p 61 A92-48468
- METAIS, OLIVIER**
Spectral large-eddy simulation of isotropic and stably stratified turbulence
p 178 A92-46254
- MEYER, M. T.**
Emissions from aircraft: Standards and potential for improvement
[PNR-90768]
p 98 N92-21740
The impact of air transport on the environment
[PNR-90876]
p 230 N92-33751
- METZGER, P. G.**
Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project
p 209 N92-24363
- MEURZEC, J. L.**
Direct coupling of fluid structure in transonic aerelasticity
p 46 N92-27954
- MEYER, DOMINIQUE**
Simulation and control of large software projects
p 258 N92-20615
- MEYER, H.-J.**
A concept for the revisions of structural inspection schedules
p 215 N92-14431
The Operational Loads Monitoring System, OLMS
p 79 N92-18586
- MEYER, HANS-L.**
The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3
p 84 N92-25591
- MEYER, J.-T.**
Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet
p 183 A92-52794
- MICHAELI, W.**
Hot melt joints for carbon fibre reinforced composites
p 213 A92-54870
- MICALSKI, WIESLAW J. J.**
Aircraft stabilization at large angles of attack
p 105 A92-47785
- MICHARD, MARC**
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications
[ETN-92-90867]
p 192 N92-19349
- MICHARD, P. J.**
Presentation of a computational code for 3-D compressible flow in complex channels and cavities
p 199 N92-27475
- MICHEL, ULF**
Jet aircraft noise at high subsonic flight Mach numbers
[DLR-FB-91-28]
p 270 N92-29997
- MICHEL, F.**
Aerosol behavior in supersonic flows
[ONERA, TP NO. 1991-155]
p 206 A92-16124
Nonstationary flight aerodynamics in a turbulent environment
[ETN-91-90102]
p 29 N92-11980
- MIDDLETON, D. H.**
The first fifty years of composite materials in aircraft construction
p 69 A92-32325
- MIGINIAC, ROLAND**
The role of simulation for the study of APIS (piloting support by synthetic imagery)
p 116 N92-28544
- MIGLIETTA, S.**
An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO₂ sources
p 212 A92-42142
- MIGNOT, J.**
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies
p 160 N92-18630
- MIGNOT, MICHEL**
Design evolution of the Ariane launching installations
p 126 N92-20726
- MIGUET, B.**
Successful transfer of technology from a research and development laboratory to an Aerospace production unit
p 4 A92-51808
- MIKHALEV, M. A.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture
p 222 A92-35007
- MILES, P. E.**
Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft
p 137 N92-24504
- MILFORD, C. M.**
Configuration effects on the ingestion of hot gas into the engine intake
p 73 A92-45315
- MILLER, ANDRZEJ**
Concept of a one-dimensional model of the dynamic behavior of a gas turbine
p 96 A92-47791
- MILLER, BARRY**
High costs force avionics links
p 88 A92-22000
- MILLER, P.**
The application of high pressure ejectors to reaction control systems
p 93 A92-16666
- MILLER, S.**
Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study
p 231 A92-52876
- MILLER, S. C.**
The search for new materials
[PNR-90777]
p 145 N92-21744
- MINK, K.-H.**
Steps toward acceptance
p 63 N92-19046
- MINUTO, A.**
The G-222 aircraft individual tracking programme
p 78 N92-18582
- MIQUEL, JAIME**
Gravity effects on reproduction, development, and aging
p 244 A92-34193
- MIRICA, D.**
An aerodynamical analysis of 'seesaw' type rotor for autogyro
p 24 A92-52034
- MIRRA, C.**
Columbus user support organization concept in Italy
p 119 A92-32465
- MISTRETTA, IGNAZIO**
Issues for the integration of satellite and terrestrial cellular networks for mobile communications
p 159 N92-30941
- MITCHELL, N. A.**
ASTOVL propulsion systems: Configuration and concept choice
[PNR-90809]
p 100 N92-27041
- MITCHELL, P. L.**
The UK element of the Maestro-1 SAR campaign
p 223 A92-44167
- MITEV, V.**
Aerosols and polar stratospheric clouds measurements during the EASOE campaign
p 229 N92-29306
- MOEHLER, O.**
Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances
p 232 A92-55441
- MOEK, G.**
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment
p 59 A92-24946
Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDIF
[NLR-TR-88108-U]
p 64 N92-19491
- MOENG, C. H.**
Large-eddy simulation of the convective boundary layer - A comparison of four computer codes
p 173 A92-40054
- MOENS, F.**
Construction of a numerical optimization method for the definition of hypersupported profiles
[ONERA-RSF-43/1736-AY-146A]
p 202 N92-28788
- MOERL, PETER**
Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex
p 234 A92-13336
- MOFFATT, H. K.**
Helicity in laminar and turbulent flow
p 177 A92-45089
- MOFIZ, U. A.**
Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma
[DE92-614464]
p 284 N92-22653
- MOHR, W.**
Numerical investigation of fluid-structure-interaction problems with the finite element method
p 196 N92-23844
- MOIN, PARVIZ**
A dynamic subgrid-scale eddy viscosity model
p 203 N92-30649
- MOIR, I. R. M.**
An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution
p 32 N92-13015
- MOLINA, R.-C.**
Fast finite element solvers for reentry flows
p 35 N92-14988
- MOLINERO, I.**
Dispersion curves analysis for bonded plates at low Fd
p 217 A92-13540
- MOLINIER, G.**
Vigilance of aircrews during long-haul flights
p 247 A92-45021
- MOLLARD, R.**
Vigilance of aircrews during long-haul flights
p 247 A92-45021
- MOLLARD, REGIS**
Vigilance in transport operations - Field studies in air transport and railways
p 249 A92-11173
- MOLTON, P.**
Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements
[ONERA-RT-47/1147-AY-146A-P]
p 52 N92-32800
- MOLTON, PASCAL**
Basic experiment on a supersonic vortex flow around a missile body
p 19 A92-41545
- MOMIGLIANO, ALBERTO**
A constraint satisfaction approach to operative management of aircraft routing
p 54 A92-25181
- MONACO, ROBERTO**
Shock-wave onset with chemical dissociation by the discrete Boltzmann equation
p 182 A92-52785
- MONACO, S.**
On the nonlinear adaptive control of a flexible spacecraft
p 137 N92-24499
- MONNIER, J. C.**
Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry
[REPT-90/55]
p 187 N92-12216
- MONNOYER, FRANCOIS**
Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows
[MBB-FE211-S-PUB-449]
p 42 N92-22179
Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation
p 42 N92-22183
- MONSERAT, G.**
Study on the requirements for the installation of a CES and habitability centre
p 254 N92-27007
- MONTENBRUCK, O.**
Estimation of attitude thruster activity of spacecraft on Sun acquisition mode
p 138 N92-24755
- MONTERO, EUGENIO O.**
Iberia's Aeronautical Mapping Application (ACA1)
p 60 A92-37073
- MONTI, R.**
An economic benefit deriving from space activities - Integration between science institutions and industry
[IAF PAPER 92-0177]
p 279 A92-55635
Aspects of non-equilibrium in arc-heated wind-tunnel simulation
p 114 N92-15012
- MONTI, RODOLFO**
Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique
p 26 A92-54308
- MONTIGNY-RANNOU, F.**
Resolution of Navier-Stokes equations around profiles: Drag evolution
[ONERA-RTS-86/1685-AY-156A]
p 186 N92-11310
Drag prediction using computation methods
[ONERA-RSF-82/1685-AY-154-4]
p 41 N92-19682
- MOORE, D. R.**
Asymmetric oscillations in thermosolutal convection
p 164 A92-19964
- MOORE, J. C.**
A comparison of satellite sounding data and aircraft measurements within a mature polar low
p 237 A92-32489
- MOORE, P.**
Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance
p 122 A92-15808
Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients
p 123 A92-15818
- MOORES, T. C.**
Software methodologies for safety critical systems
p 257 N92-12467
- MORAWSKI, JANUSZ M.**
Pragmatic simulation, basics and techniques
p 251 A92-45030
- MORCHOISNE, Y.**
Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid
p 185 N92-10163
Numerical simulation of vortex breakdown via 3-D Euler equations
p 185 N92-10164
Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations
p 32 N92-13018
- MORELLI, G.**
The enhancement of the Italsat spacecraft - A step forward the communication satellites
[IAF PAPER 91-473]
p 131 A92-18494
- MOREUX, V.**
A new automatic grid generation environment for CFD applications
[AIAA PAPER 92-2720]
p 21 A92-45558
- MORGADO, F. T. F.**
An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers
p 180 A92-48206

MORGAN, K.

- A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
The computation of three-dimensional flows using unstructured grids p 16 A92-37539
The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 A92-25959
Unstructured grid methods for compressible flows p 201 A92-27676

MORGANTI, F.

- A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development [IAF PAPER 91-288] p 130 A92-14714

MORGUL, OMER

- Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348

MORIN, P.

- Effects of ionizing and nonionizing radiation on aircraft p 159 A92-23301

MORINO, L.

- A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098
A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958

- A boundary integral formulation for unsteady transonic potential flows p 45 A92-27942

MORRIS, A. J.

- Fundamentals of structural optimisation p 86 A92-28470

MORRIS, ANDREW

- The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 A92-28539

MORRIS, N. A.

- A comparison of numerical predictions and experiments on under-expanded jets [AIAA PAPER 92-027] p 141 A92-56849

MORRISON, J. F.

- Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055

MORTARI, D.

- A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527

MORTCHELEWICZ, G. D.

- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973

MOSSER, P. E.

- The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760

MOULES, GILLES

- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 A92-15018

MOURICHOUX, H.

- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292

MOUYON, PHILIPPE

- Double loop control law strategy and applications to helicopter [CERT-2/7724-DELA] p 108 A92-19295

MOXON, JULIAN

- Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
Behind the screens p 59 A92-25520

MUELLER-REMMERS, P. L.

- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 A92-27027

MUELLER, BERNHARD

- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 A92-33996

MUELLER, C.-A.

- Hypersonic configurations in slow speed flight p 43 A92-24394

MUELLER, CHRISTOPH

- Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 A92-17311

MUELLER, J.-D.

- A frontal approach for node generation in Delaunay triangulations p 201 A92-27680

MUELLER, U. R.

- Computation of viscous phenomena in unsteady transonic flow p 46 A92-27949

MUNKEL, C.

- Trial of a slant visual range measuring device p 210 A92-31043

MUGELLES, R.

- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 A92-23975

MUGGLI, W.

- 'A new proposal for an old problem' - The right engine for the night helicopter p 96 A92-56281

MUIR, HELEN

- The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998

MUIR, HELEN C.

- The development of a working model of flight crew underload p 249 A92-13019

MULARD, V.

- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 A92-15018

MULDER, J. A.

- Modelling and identification of flexible spacecraft p 131 A92-15409

MULERO, M.

- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 A92-21955

MULLER, C.

- Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405

MULLER, O.

- Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405

MULLET, B.

- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 A92-20600

MUNDING, G.

- Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208

- High energy propulsion units for the year 2000 [ETN-92-90989] p 129 A92-20249

MUNDT, C.

- Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 A92-19296

MUNDT, CHRISTIAN

- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB-FE211/S/PUB/466] p 204 A92-30674

MUNDUS, BERNHARD

- Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames [ETN-92-92103] p 205 A92-33916

MUNK, J. R.

- The design challenge of a long endurance airship [AIAA PAPER 92-1266] p 69 A92-33344

MURSULA, K.

- CAPS-plasma spectrometer for the Cassini spacecraft p 140 A92-10565

MURTHY, T. K. S.

- Computational methods in viscous aerodynamics p 11 A92-21976

MUSAT, V.

- A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028

MYHRE, GRETE

- Aviation psychology in the operational setting p 250 A92-13550

- Domestic problems and aviator family support p 251 A92-13555

N

NAEJE, M. C.

- Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949

NANBU, K.

- Force and heat transfer on a disc in rarefied flow p 25 A92-52764

NANNONI, F.

- Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350

NAPOLITANO, LUIGI G.

- Linear acoustics in gas mixtures with rate processes p 269 A92-15013

NARKIEWICZ, JANUSZ

- General model of isolated helicopter blade for stability investigation p 71 A92-35774

- Simulation of helicopter see-saw rotor motion p 74 A92-56287

NEDELICHEV, N. M.

- Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007

NELISSEN, LAURENTIUS NICOLAAS IDA HUBERTUS

- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 A92-18479

NENCHEV, DRAGOMIR

- Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704

NETTER, GASTON

- FALKE: Winged re-entry vehicle flight control p 136 A92-24454

NETTERFIELD, M. P.

- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006

NETZE, C.

- Hot melt joints for carbon fibre reinforced composites p 213 A92-54870

NEUNABER, R.

- Aircraft tracking for structural fatigue p 79 A92-18584

NEUNZERT, H.

- Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734

- Rarefied gas flow around a disc with different angles of attack p 25 A92-52753

NEWMAN, S. J.

- The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849

NICHOLAS, D. J.

- Compressing the compressor [PNR-90824] p 99 A92-21848

NICHOLAS, O. P.

- A progress report on ASTOVL control concept studies under the VAAC programme p 104 A92-45319

- Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 A92-28652

NICOL, D. J.

- An evaluation of in-cabin safety features in passenger aircraft [ETN-92-90656] p 55 A92-20794

NICOLAES, J. M. J. A.

- Fokker 50 flameouts in icing conditions p 71 A92-35940

NICOLAOU, D.

- Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 A92-18089

- Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 A92-18234

- Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 A92-18340

NICOLAS, O.

- Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 A92-18630

NICOUT, D.

- New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600

NIEDERDRECK, P.

- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 A92-14977

NIESL, GEORG

- BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344

NIEUWKERK, L. R.

- Quantitative estimation of secondary surveillance radar information p 59 A92-24943

NIEUWPOORT, A. M. H.

- A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172

NIEUWSTADT, F. T. M.

- Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054

NIKOLASHIN, G. F.

- Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214

NILSSON, JOHNNY

- GPS/GLONASS user systems in Sweden p 61 A92-38384

NINANE, VINCENT

- Rib cage shape and motion in microgravity p 247 A92-56944

NIPPRESS, K. R.

- Sentinel 1000 flight test programme overview and preliminary results [AIAA PAPER 92-1229] p 69 A92-33326

NITSOPOULOS, IOANNIS

- Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 A92-14382

NIVEN, A. J.

- Measurements of the dynamic stall vortex convection speed p 27 A92-56351

- NIXON, D. A.**
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- NOBACK, R.**
Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
Atmospheric turbulence spectra and correlation functions [NLR-TP-89217-U] p 234 N92-28689
Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
- NOBINDER, P. I.**
Sweden and the space plane - A small country with high ambition [AIAA PAPER 91-5005] p 119 A92-17804
- NOGUES, P.**
Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- NONWEILER, T. R. F.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- NORDENG, THOR E.**
A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
- NORDMANN, R.**
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 N92-14360
- NORDSTROM, JAN**
Extrapolation procedures for the time-dependent Navier-Stokes equations p 19 A92-41289
- NORMAND-CYROT, D.**
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
- NORMAND, X.**
Numerical simulation of transition to turbulence in free-shear layers p 187 A92-26221
- NORMAND, XAVIER**
Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- NORRIS, GUY**
The engine inside p 94 A92-36126
Shear progress p 3 A92-40880
777 shaping up p 74 A92-52300
- NORRIS, P.**
Why is space software special? p 258 N92-20626
- NORTH, DAVID M.**
A340 handling, cockpit design improve on predecessor A320 p 73 A92-47969
- NORTON, R. J. G.**
The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
- NORY, PASCAL**
From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot [ONERA, TP NO. 1991-216] p 260 A92-26368
- NOVAK, L.**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- NOWICKI, TADEUSZ**
The CSMA/CD local area network for hospital services p 157 N92-15284
- NOWOTARSKI, I.**
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
- NSI MBA, M.**
Experimental and computational studies of hovering rotor flows p 22 A92-46954
- NYBERG, E.**
The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- NYGARD, M. K.**
Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 N92-18574
- O**
- O'BRIEN, J.**
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- O'NEILL, A.**
The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
The effects of resolution on diagnostic calculations of coupling between radiation and dynamics p 238 A92-47734
- O'TOOLE, KEVIN**
Sunrise aerospace p 3 A92-46448
- ODAM, G. A. M.**
Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
- ODORICO, J.**
Use of composite materials for aeronautical structure p 143 A92-15303
- OLKER, H.-CHR.**
Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
- OENGOEREN, A.**
Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045
- OETTL, HERWIG**
Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
- OFFENBECK, HANS-GUENTER**
Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- OHAYON, R.**
Elasto-acoustic damped vibrations - Finite element and modal reduction methods [ONERA, TP NO. 1992-52] p 218 A92-48613
- OLDFIELD, M. L. G.**
An Axial Turbopump [ASME PAPER 91-GT-1] p 211 A92-15501
- OLEJAK, D.**
Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784
- OLEJNIK, A.**
A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
- OLIVARI, D.**
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 N92-21237
- OLLERHEAD, J. B.**
Airport noise contours - Converting from NNI to Leq p 227 A92-39053
- OLOVSSON, S.**
Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- OLSEN, GEROLD**
Computation of aircraft noise exposure using digitized topography data p 227 A92-39058
- OLSEN, H.**
Advanced method for single event aircraft noise analysis p 266 A92-39060
- OLSSON, MATS-OLOF**
Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
- OMRANI, A.**
A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 N92-23846
- ONATE, E.**
Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 N92-14990
- ONG, C. L.**
Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
- ONKEN, R.**
Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- ONOFRI, M.**
Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
- ONUR, H. S.**
Laminar channel flow over a square step p 180 A92-48254
- OOSTERLEE, C. W.**
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 N92-14321
A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 N92-30454
- OPRISIU, C.**
On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
- ORAEVSKII, V. N.**
A method for determining the potential of a spacecraft p 131 A92-23433
- ORAM, S. D.**
Concept for a European Space Station: Habitability, life support, and laboratory facilities p 254 N92-27023
- ORAN, E. S.**
The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143
- ORKISZ, MAREK**
The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
- ORLANDI, PAOLO**
Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
- ORLINSKA, MALGORZATA**
Automation of the measurement process in the N2 wind tunnel with the SPITA N-3 system p 110 A92-12347
- OSULLIVAN, DERMOT M.**
Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- OWEN, J. M.**
Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
- OWEN, YVONNE**
The laminar natural convection on a horizontal surface [AERO-REPT-9015] p 191 N92-18236
- OZCAN, OKTAY**
Cylinder-induced shock-wave boundary-layer interaction p 15 A92-31188
- OZDEMIR, I. B.**
Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297
- P**
- PAAR, G.**
Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473
- PADDAY, JOHN F.**
The weightless experience p 245 A92-16403
- PAEVIKE, H.**
The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma p 140 N92-10563
- PAGAN, DIDIER**
Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
- PAGAN, G.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- PAGE, G. J.**
Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- PAGENDARM, HANS-GEORG**
Three-dimensional computer graphics in flow visualization p 189 N92-16227
- PAGGI, B.**
EH 101 ship interface trials: Flight test programme and preliminary results p 82 N92-21964
- PAGLIOCCA, G.**
Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 N92-15012
- PAGNANO, G.**
Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
- PAGNANO, GIUSEPPE**
EUROFAR airframe aerodynamic design p 70 A92-35750
- PAGNIEZ, PIERRE**
The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544
- PAICE, S.**
Low cost spacecraft attitude sensors p 140 N92-24458
- PAILHAS, G.**
Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
Turbulence control by intake [CERT-RF-67/5004-37] p 186 N92-12211
Characteristics of a boundary layer in a leading edge vortex p 31 N92-13012
- PAILLARD, JACQUES**
Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- PAILLERE, H.**
Multidimensional upwind methods for unstructured grids p 201 N92-27675
- PAILLOUS, A.**
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

- PAILLOUS, ALAIN**
Spacecraft thermal control coatings p 151 N92-24829
- PAIVA, MANUEL**
Rib cage shape and motion in microgravity p 247 A92-56944
- PALACIAN, J.**
Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728
- PALASIS, D.**
Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340
- PALLEGIOIX, JEAN-FRANCOIS**
Transitional flows around re-entry bodies p 38 N92-15035
- PALLI, E.**
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 N92-21237
- PALLISTER, KEITH**
Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809
- PALMA, J. M. L. M.**
Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164
- PALMBERG, BJORN**
Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
- PALOSCIA, S.**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- PALTRINIERI, MASSIMO**
A constraint satisfaction approach to operative management of aircraft routing p 54 A92-25181
- PALUCH, B.**
Design and manufacturing of torsional flexible blade models p 71 A92-35780
- PAMPALONI, P.**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- PANDEY, SANDEEP**
Aircraft control for take-off in windshear p 104 A92-36990
- PANDOLFI BIANCHI, MIRIAM**
Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
- PANDOLFI, MAURIZIO**
Nonequilibrium 3D flows of air through inlets p 200 N92-27487
- PAO, L. Y.**
Physical and computational modelling of stratified shear flows [AERO-REPT-8909] p 190 N92-17974
- PAOLETTI, STEFANO**
An unaffected implicit scheme for 3D inviscid transonic flows [AIAA PAPER 92-2668] p 20 A92-45523
- PAONESSA, A.**
Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- PAONESSA, F. A.**
Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089
Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234
Modelling of interfacial and thermocline waves [AERO-REPT-9004] p 243 N92-18340
- PAPAGEORGIOU, D.**
On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655
- PAPAILOU, K.**
Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
- PAPAILOU, K. D.**
Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533
Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
- Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- Unsteady Euler calculations in 3D internal aerodynamics p 199 N92-27470
- PAPATHANASIOU, A.**
Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- PAPAVERGOS, PANAYIOTIS G.**
Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 N92-32856
- PAPENBERG, H.**
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- PAPIRNYK, O.**
Aerosol behavior in supersonic flows [ONERA, TP NO. 1991-155] p 206 A92-16124
- PARDINI, S.**
Use of target spectrum for detection enhancement and identification p 157 N92-19155
- PARÉ, A.**
Structural optimization of aircraft practice and trends p 83 N92-23239
- PARISSE, M.**
A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft [IAF PAPER 92-0031] p 132 A92-55527
- PARKER, E. A.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- PARKER, JON**
Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809
- PARKINSON, R. C.**
The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
Organizational impediments to the reduction of costs of space programmes [IAF PAPER 91-639] p 278 A92-20591
- PARMIGGIANI, F.**
Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104
- PARSLEY, R. C.**
Plug engine systems for future launch vehicle applications [IAF PAPER 92-0647] p 141 A92-57090
- PARSONS, PHILIP**
Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
- PARTHIER, W.**
Extension of the Frankfurt COMPAS for general application p 63 N92-19048
- PARTS, U.**
Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476
- PASCAL, FREDERIC**
Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
- PASCAL, PH.**
Modelling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
- PASCAL, R. W.**
Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 N92-29213
- PASSALACQUA, M.**
Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
- PASSCHIER, D. M.**
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 N92-14004
- PASTOR, M.**
Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007
- PATEK, J.**
Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- PATTON, R. J.**
An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908
- PAULSON, G. A.**
Transition to cooperative ATM system requires commitment p 59 A92-23297
- PAULSON, GEORGE A.**
A European perspective on the co-operative air traffic management concept p 60 A92-33427
- PAURON, CLOTHILE**
Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- PAUS, M.**
A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming [AIAA PAPER 92-4378] p 260 A92-55182
- PAWU, KYAW THA**
Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506
- PEACE, A. J.**
The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
- PEAKE, N.**
The interaction between a high-frequency gust and a blade row p 267 A92-54484
- PECINA, P.**
On the radiant determination of meteors p 283 A92-18593
- PECORA, M.**
A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- PEDERSEN, LEIF T.**
Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- PEDERSEN, TORBEN S.**
Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- PEDLOSKY, J.**
The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves p 166 A92-23292
- PEDRIZZETTI, GIANNI**
Insight into singular vortex flows p 183 A92-53052
- PEDRO, JIMOH**
Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft p 105 A92-47784
- PEGNEAUX, JEAN-CLAUDE**
Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- PEIRO, J.**
A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
The computation of three-dimensional flows using unstructured grids p 16 A92-37539
The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
Unstructured grid methods for compressible flows p 201 N92-27676
- PEKOLA, J. P.**
Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 N92-21773
Ultrasonic investigation of (3)He-A vortices in low magnetic fields [PB92-142256] p 265 N92-23665
- PELIPENKO, P.**
Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
- PELLEBERGS, PER**
JAS 39 Gripen flight test report p 72 A92-40030
- PELLEGRINI, P. F.**
Use of target spectrum for detection enhancement and identification p 157 N92-19155
- PELLETIER, GUY**
Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei p 284 A92-16523
- PELON, J.**
Single alexandrite laser source for airborne DIAL system p 210 A92-51228
Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037
- PENAZ, J.**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- PENNATI, V.**
An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- PERADZYNSKI, Z.**
Differential forms and fluid dynamics p 176 A92-42535
- PERAIRE, J.**
A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665
The computation of three-dimensional flows using unstructured grids p 16 A92-37539

- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- Finite element methods for integrated aerodynamic heating analysis [NASA-CR-190353] p 43 N92-25959
- Unstructured grid methods for compressible flows p 201 N92-27676
- PERALA, R. A.**
The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- PERALES, J. M.**
A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- PERBET, JEAN-NOEL**
Concept for future cockpits p 88 A92-16148
- PERDICHIZZI, ANTONIO**
Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
- PERDU, M.**
Advanced spacecraft concepts using electrical propulsion [AIAA PAPER 92-3513] p 132 A92-49046
- PEREIRA, J. C. F.**
Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476
- PEREZ DE LABORDA, A.**
The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
- PEREZ, EMILIO**
Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
- PEREZ, F.**
New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
- PERINO, MARIA A.**
Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- PERINO, MARIA ANTONIETTA**
Moon base habitability aspects p 254 A92-27026
- PERKINS, A. R.**
Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 N92-18790
- PERKINS, R. J.**
Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460
- PEROL, P.**
ESA power standard p 141 N92-13174
- PEROTTO, ALFRED**
Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118
- PEROTTO, VALTER**
A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881
- PERRIER, P.**
Computational procedures for preliminary design p 84 N92-23952
- PERRIN, G.**
Model and computation of discrete jets in crossflow p 165 A92-21505
- PERRIN, M. Y.**
Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014
- PERRONNET, A.**
Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
- PERTILE, R.**
Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782
- PERUCCHINI, J.**
Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
- PETER, G.-M.**
The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048
- PETER, O.**
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP p 219 N92-14420
- PETIAU, C.**
Structural optimization of aircraft practice and trends p 83 N92-23239
- Structural optimization of aircraft p 86 N92-28472
- PETIT, M.**
Aircraft experiments with visible and infrared sensors p 206 A92-37159
- PEUBE, J.**
Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
- PEUBE, J. L.**
Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
- PEYRET, R.**
Adaptive spectral methods with application to mixing layer computations p 182 A92-52404
- PEYROT, P.**
The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
- PEZZULLO, G.**
Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
- PFITZNER, MICHAEL**
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703
- PHAM, PHILIPPE**
Normalization, reliability and validation of information for spatial operations p 157 N92-15285
- PHILIPPE, JEAN-JACQUES**
Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics [ONERA, TP NO. 1992-27] p 73 A92-48589
- PHILPOT, M. G.**
Practical considerations in designing the engine cycle p 102 N92-28460
- PHULPIN, THIERRY**
TIMS calibration correction by comparison with PRT5 p 223 N92-11412
- PIANESE, C.**
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 N92-14328
- PIANKO, M.**
Combat aircraft jet engine noise studies [ONERA, TP NO. 1991-192] p 266 A92-26353
- PICCINI, P.**
Use of target spectrum for detection enhancement and identification p 157 N92-19155
- PICCO, E.**
High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- PICKARD, A. C.**
Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005
- PIDD, M.**
Asymmetric vortex flow over circular cones p 32 N92-13014
- PIDGEON, A.**
Operational aspects of spacecraft autonomy p 131 A92-24207
- PIERS, M. A.**
A knowledge-based assistant for diagnosis in aircraft maintenance p 5 N92-12538
- Application of knowledge-based systems for diagnosis of aircraft systems [NLR-TP-90192-U] p 57 N92-28655
- PIETARINEN, KIMMO**
Low pressure impactor with electrical concentration detection p 209 N92-10534
- PIKE, J.**
Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691
- PIKE, WILLIAM S.**
Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382
- PIKIENY, JERZY**
Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
- PILIDIS, PERICLES**
The selective bleed variable cycle engine [ASME PAPER 91-GT-388] p 93 A92-15720
- PILKINGTON, G.**
The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574
- PILKINGTON, J. L.**
An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 N92-11222
- PILKINGTON, MICHAEL**
CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549
- PINOTTI, ROBERTO**
Multi-cultural components and keys for European worldwide space programs p 122 N92-27008
- PIOMELLI, UGO**
A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
- PIQUET, J.**
Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- PIT, FABRIENNE**
Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
- PITARI, G.**
The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model p 239 A92-53349
- PITCHER, P. D.**
A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- PITTE, S. C. P.**
Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926
- PIVA, R.**
A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
- A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
- A boundary integral approach in primitive variables for free surface flows p 187 N92-14304
- PLANTIER, JUSTIN**
Does the future lie in binocular helmet display? p 253 N92-19019
- PLATT, J. T.**
Evolution of ASTOVL aircraft design p 72 A92-45311
- PLATTEN, J. K.**
Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
- PLATZ, K.**
The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049
- PLISSONNEAU, B.**
The development of a new light, single engine helicopter family p 70 A92-35734
- PLOT-LOCATELLI, SYLVIE**
Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations [ONERA-RSF-24/1408-AY-150A] p 51 N92-32773
- PLOTARD, PATRICE**
Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 N92-12065
- PLOVISING, BIRGER**
DANSIM - Danish Airport Noise Simulation Model - Basic principles, experience, and improvements p 227 A92-39055
- DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
- PODAIRE, ALAIN**
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- POELAERT, D.**
SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
- POELZLEITNER, W.**
Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473
- POERTNER, T.**
Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
- POGU, M.**
Concerning the functional solution of transonic flows p 11 A92-21318
- POINSOT, T.**
The coherent flamelet model for propulsion applications p 147 N92-27486
- POINSOT, THIERRY**
Direct simulation and modeling of premixed turbulent combustion p 147 A92-20344
- POLACSEK, C.**
High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel [ONERA, TP NO. 1991-124] p 9 A92-16102

Q

- Influence of geometrical parameters on helicopter rotor high speed impulsive noise
[ONERA, TP NO. 1992-40] p 267 A92-48601
- POLAK, MAURICE V.**
Conflict of laws in the air - Some legal issues of international aircraft financing and leasing
p 280 A92-35591
- POLL, D. I. A.**
A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications)
[AERO-REPT-9002] p 190 N92-18088
Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow
[AERO-REPT-9007] p 40 N92-18231
Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate
[AERO-REPT-9008] p 40 N92-18232
Computation of laminar flow over cavities
[AERO-REPT-9013] p 191 N92-18235
Towards the computation of turbulent hypersonic flows
[AERO-REPT-9106] p 40 N92-18318
On the approximate representation of velocity and shear stress distributions in low-speed boundary layers
[AERO-REPT-9012] p 192 N92-18319
The installation of the AVRO 9 by 7 foot low-speed wind tunnel at the University of Manchester (England)
[AERO-REPT-9005] p 114 N92-18341
- POLLE, B.**
Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- POLVANI, LORENZO M.**
The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
- POLYCHRONIADIS, MICHEL**
Generalized higher harmonic control - Ten years of Aerospace experience p 104 A92-35769
- POLZ, G.**
Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project)
p 27 A92-56332
- PONGRATZ, HANS W.**
Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- PONTON, A. J.**
The evaluation of canard couplings at high angles of attack
[AIAA PAPER 92-0281] p 12 A92-25735
- PONZI, C.**
Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145
- POOLE, L. R.**
Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 N92-14541
- POPE, V. D.**
The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
The effects of resolution on diagnostic calculations of coupling between radiation and dynamics
p 238 A92-47734
- PORTABELLA, F. GOMEZ**
Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955
- PORTE, F.**
Benefits of electric propulsion for orbit injection of communication spacecraft
[AIAA PAPER 92-1955] p 140 A92-31709
- PORTER, B.**
Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
- PORTERIE, B.**
A numerical simulation of injection of droplets in a compressible flow
[AIAA PAPER 92-2929] p 180 A92-47899
- POT, T.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels
[ONERA, TP NO. 1992-39] p 111 A92-48600
- POTOCKI DE MONTALK, J. P. P.**
Computer software in civil aircraft p 256 A92-49302
- POTTIEZ, M.**
CFView - An advanced interactive visualization system based on object-oriented approach
[AIAA PAPER 92-0072] p 255 A92-22185
- POUWELS, H.**
First results from the Netherlands SAR testbed 'PHARS' p 221 A92-34903
- POVINELLI, LOUIS A.**
Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523

- POZZI, A.**
Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method
p 179 A92-46918
- PRANDI, B.**
The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760
- PRAZAK, J.**
Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- PREECE, A.**
The Electron Spectrometer for the Cassini spacecraft
p 140 A92-53415
- PRENDIN, W.**
In-orbit experiment of object capture technology
[IAF PAPER 91-002] p 251 A92-12427
- PREVOT, LAURENT**
Using the radiative surface temperature in energy budget studies over plant canopies p 223 N92-11506
- PREVOT, T.**
Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- PRICE, J. D.**
On the relation between total ozone and meteorology
p 236 A92-27796
- PRICE, J. N.**
An integrated approach to developing tough epoxies
p 145 A92-51563
- PRIESETT, KLAUS**
Experiences in the development of rotary joints for robotic manipulators in space applications
p 213 N92-25073
- PRIEST, E. R.**
A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574
- PRIESTMAN, G. H.**
Internal flow modelling of vortex throttles
p 168 A92-27385
- PRIEUR, J.**
Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors
[ONERA, TP NO. 1991-178] p 10 A92-16140
Influence of geometrical parameters on helicopter rotor high speed impulsive noise
[ONERA, TP NO. 1992-40] p 267 A92-48601
- PRIGGE, R.**
Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
- PRINOS, P.**
Three dimensional flow in sharp bends
p 200 N92-27481
- PRISCO, GIULIO**
Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 N92-15033
- PROBERT, BRIAN**
Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions
[AIAA PAPER 92-3985] p 75 A92-56809
- PROVENCIO, ANTONIO C.**
Iberia's Aeronautical Mapping Application (ACA)
p 60 A92-37073
- PRUD'HOMME, R.**
Behavior of a suspension in the presence of a potential vortex
[ONERA, TP NO. 1991-140] p 163 A92-16114
- PRUVOST, M.**
Study of interactions on anemoclinometric sensors
[REPT-90/30] p 113 N92-12006
- PUCHE, T. M.**
Investigation of the tail buffeting of the C-101
p 26 A92-53253
- PUECH, J. F.**
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes
p 134 N92-23836
- PUILLET, C.**
Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848
- PULVIRENTI, M.**
From vortex layers to vortex sheets
p 181 A92-50108
- PUSKEPELEIT, MONIKA P.**
Experiences during a 14 months overwintering with respect to potential human habitation on other planets
[IAF PAPER 92-0249] p 244 A92-55688
- PYNE, C. R.**
A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345

QIAN, Y. J.

- Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
- QIN, N.**
Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
- QUAGLIOTTI, F. B.**
Experimental investigation of vortex dynamics on delta wings
[AIAA PAPER 92-2731] p 21 A92-45565
- QUANDIEU, P.**
G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
Circulatory biomechanics effects of accelerations p 248 N92-18991
Study of the loss of consciousness inflight by fighter aircraft pilots
[ONERA-RTS-11/3446-EY] p 249 N92-28844
- QUAST, A.**
The A320 laminar fin programme
[ONERA, TP NO. 1992-23] p 73 A92-48586
- QUELLMANN, WILFRIED**
Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547
- QUENTIN, G.**
Dispersion curves analysis for bonded plates at low F_d p 217 A92-13540
- QUEYRON, J.**
A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
- QUILLIET, C.**
Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
- QUINN, B. J.**
ASTOVL engine control p 95 A92-45321
ASTOVL engine control
[PNR-90808] p 100 N92-27040
- QUINTANA, F.**
Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 N92-14990

R

- RAASCH, S.**
Visualization of instationary flows by particle traces
p 189 N92-16234
- RACHNER, M.**
Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483
- RADDATZ, J.**
Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- RADESPIEL, R.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles
p 133 N92-14977
- RAEISAENEN, ANTTI**
Millimeter wave technology in space
p 283 N92-25782
- RAFFIN, G.**
Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- RAFFIN, M.**
Flat planes in rarefied hypersonic flows
[SESSIA-430/91-940] p 29 N92-11979
Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 N92-14995
Flat plates placed in depleted hypersonic flow
[SESSIA-430/91-960] p 50 N92-31508
- RAFIN, C.**
Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- RAGHUNATHAN, S.**
Effect of model cooling on periodic transonic flow
p 22 A92-46900
- RAGOT, ALAIN**
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- RAHIER, GILLES**
Theoretical study and prediction of BVI noise including close interactions
[ONERA, TP NO. 1991-174] p 265 A92-16138
- RAITALA, JOUKO**
Second Meeting of Finnish Space Researchers
[REPT-117(1990)] p 282 N92-25758
- RAJIYAH, H.**
Control strategies for space systems
p 137 N92-24494
- RAMACHANDRAN, K.**
Experimental and computational studies of hovering rotor flows p 22 A92-46954

- The computation and validation of hovering rotor performance p 74 A92-56285
- RAMAKRISHNAN, J.**
Control strategies for space systems p 137 N92-24494
- RAMAZZA, P. L.**
Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
- RAMETTE, PHILIPPE**
Potential hypersonic vehicles applications [AIAA PAPER 91-5086] p 1 A92-17854
- RAMSDEN, J. M.**
BA's 777 p 74 A92-51580
- RANOUX, GILBERT**
Patch-independent structured multiblock grids for CFD computations p 263 A92-47078
- RANUCCI, D.**
High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
- RAO, Y. S.**
Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
- RAPP, HELMUT**
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 N92-14054
- RAPUC, M.**
Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB/FE202/S/PUB/461] p 5 N92-30232
- RASMUSSEN, ERIK A.**
A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- RATH, W.**
Unmanned orbital servicing - From ground tests to in-orbit demonstration [IAF PAPER 92-0780] p 122 A92-57189
- RATTI, G.**
An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
- RAUENZAHN, R. M.**
A spectral model for turbulent transport p 178 A92-45095
- RAVAT, C.**
Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468
- RAVEX, A.**
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 A92-25875
- REASON, JAMES**
How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308
- REBAY, S.**
Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
- RECORD, R.**
Organisational robustness for manned space flight p 152 N92-18618
- REDAELLI, G.**
The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model p 239 A92-53349
- REDDAN, MICHEL**
The new airport aeronautic meteorological codes p 235 A92-13855
- REEB, SONIA**
Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
- REED, L. H. K.**
Recent developments at the Shoeburyness STOVL test facility p 111 A92-45314
Recent developments at the Shoeburyness (England) STOVL Test Facility [PNR-90806] p 115 N92-22096
- REES, D.**
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629
- REICH, G.**
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- REICHERT, G.**
Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302
- REIMERDES, HANS-G.**
Protection of spacecraft against meteoroid/orbital debris impacts p 134 N92-23786
- REINL, WERNER**
Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
- REISINGER, D.**
Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784
- REITZ, G.**
Long-term exposure of bacterial spores to space p 244 N92-27126
- REKKAS, C. M.**
Computation of aircraft geometric height under radar surveillance p 61 A92-40239
- RELOTIUS, KLAUS-DIETER**
FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- RENARD, P.**
Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848
- RENAUD, J.**
The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299
The Eurofar program: An European overview on advanced VTOL civil transportation system [MBB-UD-0611-91-PUB] p 58 N92-30418
- RENAUDIE, J. F.**
Flight in adverse environmental conditions p 55 N92-21680
- RENDER, M. E. J.**
Aircraft fatigue management in the Royal Air Force p 79 N92-18591
- RENEAUX, J.**
The design and testing of an airfoil with hybrid laminar flow control [ONERA, TP NO. 1992-22] p 24 A92-48585
- RENGER, WOLFGANG**
Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340
Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- RENIER, O.**
Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
- RESIDORI, S.**
Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
- RETIF, F.**
Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds p 53 A92-23302
- REUTER, R.**
Aircraft experiments with visible and infrared sensors p 206 A92-37159
Introduction: Ocean air observation p 224 N92-23381
Seaborne lidar system p 224 N92-23389
- REVAH, I.**
Main activities conducted under the International Space Year Panel of Experts on Education and Applications [IAF PAPER 92-0466] p 274 A92-55806
- RHYS-JONES, T. N.**
Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422
- RICCIARDI, A.**
CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
- RICHARD, F.**
Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
- RICHARDS, B. E.**
High resolution schemes for steady flow computation p 161 A92-10036
Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
- RICHTER, R.**
Mesh adaption for 2D transsonic Euler flows on unstructured meshes p 22 A92-47038
- RICK, W.**
Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479
- RIDDER, SVEN-OLOF**
Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter [FFA-TN-1991-22] p 76 N92-11993
- RIEDELBAUCH, S.**
Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 N92-29713
- RIEDELBAUCH, STEFAN**
On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005
- RIEDL, CH.**
Lite-Sat's for specific communication tasks p 156 N92-15232
- RIEDLER, W.**
Balloons for conjugate cusp studies in the 1990's p 233 N92-36215
- RIEGER, H.**
Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
- RIENSTRA, S. W.**
A note on the Kutta condition in Glauert's solution of the thin aerofoil problem p 16 A92-37933
- RIESCO-CHUECA, P.**
Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- RIETHMULLER, M.**
Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215
- RIGAULT, M.**
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
- RIGAULT, MICHEL**
Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- RIJCKENBERG, GERT-JAN**
Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- RIJZEBOL, K. R.**
Improvement of separations of practice bombs from a multiple bomb adapter [NLR-TP-90307-U] p 86 N92-28634
Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
- RILEY, D. S.**
Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963
- RILEY, N.**
Secondary separation from a slender wing p 6 A92-13448
- RINOIE, K.**
Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing [CRANFIELD-AERO-9113-PT-1] p 40 N92-19679
- RINZEMA, K.**
Playing with nonuniform grids p 172 A92-37936
- RISPOLI, F.**
Prediction of gas turbine combustor flow by a finite element code [AIAA PAPER 92-3469] p 181 A92-49016
- RISTIC, S.**
Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675
- RISTORI, A.**
Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- RIVA, G.**
Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
- RIZZI, A.**
Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 N92-15026
- RIZZI, ARTHUR**
Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model [AIAA PAPER 92-0195] p 11 A92-23803
Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168
- ROBERT, J. P.**
The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
Drag reduction: An industrial challenge p 44 N92-27708
- ROBERT, R.**
Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
- ROBERT, RAOUL**
Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897

ROBERTS, EMYR

Accurate current measurement using drogued buoys
employing Decca Navigator and Argos p 241 A92-12278

ROBERTS, G. T.

Effects of atomic oxygen on spacecraft materials -
Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
Interference heating near fin/body junctions on
hypersonic vehicles p 36 A92-14996

ROBERTS, GWYN

Accurate current measurement using drogued buoys
employing Decca Navigator and Argos p 241 A92-12278

ROBERTS, T. P.

A comparison of numerical predictions and experiments
on under-expanded jets [AIAA PAPER 92-4027] p 141 A92-56849

ROBERTSON, G. J.

Communication satellite system beyond the year 2000
[IAF PAPER 91-495] p 155 A92-18509

ROBICHEZ, SABINE

Future technologies for space: New product assurance
concepts p 153 A92-18650

ROBINSON, D. W.

Risk to hearing from overflight noise of military aircraft
[ISVR-TR-194] p 270 A92-22241

ROBINSON, R. J.

The e-beam sustained laser technology for space-based
Doppler wind lidar p 240 A92-29300

ROCHA, J. M. P.

Measurements and modelling of the turbulent near wake
flow of a disk with a central jet p 174 A92-40123

ROCHAT, PHILIPPE

The view from the airport p 60 A92-33438

ROCHE, JOHN

The role of crack growth in defect assessment
[PNR-90798] p 220 A92-20909

RODGER, A. S.

Antarctic studies of the cusp p 233 A92-26301

RODRIGUEZ, L. M.

Fuzzy guidance system evaluation p 259 A92-27903

RODRIGUEZ, O.

Phenomenological modeling of the wake produced by
a straight two dimensional base in subsonic flow
[REPT-90/59] p 29 A92-11982

ROE, P. L.

Multidimensional upwind methods for unstructured
grids p 201 A92-27675
A frontal approach for node generation in Delaunay
triangulations p 201 A92-27680

ROEBROEKS, GERARDUS HUBERTUS JOANNES J.

Towards GLARE: The development of a fatigue
insensitive and damage tolerant aircraft material
[ETN-92-91301] p 84 A92-24966

ROECK, W.

The IRS plasma wind tunnels for the investigation of
thermal protection materials for reentry vehicles p 114 A92-15009

ROEDSETH, O.

Object oriented hardware simulation of spacecraft
control algorithms p 259 A92-24487

ROEMER, M. G. M.

The main lines of the research programs remote sensing:
Climate and environment [BCRS-91-25] p 230 A92-29499

ROENNEKE, AXEL J.

Reentry control of a low-lift maneuverable spacecraft
[AIAA PAPER 92-4455] p 124 A92-55216

ROESCH, ERIKA

Investigation on the control of a Karman vortex street
[MPIS-99/1990] p 40 A92-17315

ROESLER, FRANK

Evaporation and energy fluxes in the atmospheric
boundary layer during Lotrex p 234 A92-13336

ROESLER, UWE

Remote sensing of atmosphere with aircraft borne lidar
systems p 234 A92-26347

ROGG, B.

Adaptive methods in computational fluid dynamics of
chemically reacting flows p 172 A92-37573

ROLLAND, P.

Development of cryocoolers for space applications using
hydrodynamic gas bearings p 154 A92-25875

ROLLET, PHILIPPE

EUROFAR airframe aerodynamic design p 70 A92-35750

ROMANO, G. P.

Experimental testing of Taylor's hypothesis by L.D.A.
in highly turbulent flow p 162 A92-13671

ROMEO, BERNARD

AGILE: An expert system for large space project
management p 276 A92-20621

ROMERO, E.

The Hermes nominal landing sites
[IAF PAPER 92-0884] p 125 A92-57272

RONDINELLI, G.

LEOSTAR - A small spacecraft for LEO communications
missions p 120 A92-46468

ROSE, C.

Radar-optronic tracking experiment for short and
medium range aerial combat p 61 A92-48468

ROSELL-LLOMPART, J.

Brownian-motion limited aerodynamic focusing of heavy
molecules p 182 A92-52722

ROSS, A. JEAN

Control of forebody vortices by suction at the nose of
the RAE high incidence research model p 32 A92-13022

ROSS, HANNES

Dynamic wind tunnel tests on control of forebody vortices
with suction p 107 A92-18793

ROTH, G. L.

X-31 enhancement of aerodynamics for maneuvering
beyond stall p 80 A92-18779

ROTH, G. L.

Reliability, availability, maintainability, and safety
p 216 A92-18639

ROTT, HELMUT

Multi-parameter airborne SAR experiments at an Alpine
test site p 222 A92-35173

ROUBINE, OLIVIER

Ada p 255 A92-19395

ROUCHON, JEAN

Evaluation of the effects of the environment on the
behavior of the primary structures of composite material
aircraft in service: Historic and current situation p 146 A92-33048

ROUCHON, P.

On the Arnol'd stability criterion for steady-state flows
of an ideal fluid p 165 A92-21506

ROUGES, J. M.

Large thin composite thermostructural parts p 134 A92-23821

ROUHIAINEN, V.

Quality assurance of safety and risk analysis p 215 A92-18629

ROUMES, CORINNE

Does the future lie in binocular helmet display? p 253 A92-19019

ROUSSAUD, A.

Mechanisms of high-current pulses in lightning and
long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678

ROUX, BERNARD

Numerical study of an oscillating cylinder in uniform flow
and in the wake of an upstream cylinder p 172 A92-36347

ROUZAUD, O.

A deficit approach to three dimensional incompressible
flows [CERT-RF-39/5025-36] p 192 A92-19294

RUDGYARD, MICHAEL A.

Cell vertex methods for compressible gas flows p 197 A92-26599

RUFENACH, C. L.

Comparison of aircraft synthetic aperture radar and buoy
spectra during NORCSEX '88 p 242 A92-34878

RUFFLES, P. C.

Keys to excellence in design and manufacture
[PNR-90781] p 276 A92-20927

RUIJGROK, G. J. J.

Elements of airplane performance [ISBN 90-6275-608-5] p 68 A92-26550

RUPPERSBERG, GERHARD

Cirrus clouds and condensation trail on 18 Oct. 1989
over the North sea (ICE '89). Determination of height and
optical depth using ALEX, AVHRR and HIRS p 234 A92-26340

Remote sensing of atmosphere with aircraft borne lidar
systems p 234 A92-26347

RUSSIER, M.

P120 programme - First results of the pre-development
phase p 1 A92-14447

The development of a new light, single engine helicopter
family p 70 A92-35734

RUSSO, G.

SIMOUN and Scirocco wind tunnel nozzle viscous flow
study p 113 A92-14999

High enthalpy nozzle flows p 36 A92-15000

Aspects of non-equilibrium in arc-heated wind-tunnel
simulation p 114 A92-15012

RYDEN, K. A.

The development status of the Space Technology
Research Vehicle [IAF PAPER 91-008] p 118 A92-12433

RYRIE, SUSAN C.

Unsteady three-dimensional Benard convection -
Light-scattering, statistics and chaos p 168 A92-27379

Mixing by chaotic advection in a class of spatially periodic
flows p 170 A92-31451

S

SAAGER, P.

The role of systems simulation for the development and
qualification of ATTAS p 117 A92-28548

SABETTA, F.

Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737

SACCHI, ENRICO

A systematic approach to thermal balance test
evaluation and thermal mathematical model correlation for
spacecraft thermal design p 139 A92-25881

SACHER, P. W.

Introduction to Special Course on Engineering Methods
in Aerodynamic Analysis and Design of Aircraft p 84 A92-23951

SAGNIER, P.

Analysis tools of ONERA and DLR for the
aerothermodynamics of reentry vehicles p 133 A92-14977

SAID, FREDERIQUE

Experimental study of the atmospheric marine boundary
layer from in-situ aircraft measurements (TOSCANI-T
campaign) - Variability of boundary conditions and eddy
flux parameterization p 235 A92-14052

SAINT AUBERT, P.

Benefits of electric propulsion for orbit injection of
communication spacecraft [AIAA PAPER 92-1955] p 140 A92-31709

SAKELLARIOU, N.

Prediction and measurement of jet flowfield features for
ASTOVL aircraft p 20 A92-45318

SALAM, A.

Secondary flow investigation inside the passage of a
compressor cascade p 19 A92-42124

SALEEM, A.

Why quantify risk? p 153 A92-18637

An evaluation of payload safety requirements for ESA
manned spacecraft p 153 A92-18655

SALEIN, MARIANNE

Materials and Structures Research Department:
Scientific report (1990) [ETN-92-90727] p 82 A92-22000

SALIVEROS, E.

An experimental investigation of the oblique blade-vortex
interaction p 19 A92-43447

SALK, M.

Crystal growth experiments on Russian unmanned
spacecraft [IAF PAPER 92-0934] p 151 A92-57307

SALMINEN, E.

Modernized MBB panel code: User's guide including
background theory [PB92-136431] p 43 A92-22233

SALOMAA, M. M.

Superfluid vortex nucleation in He-3 flow p 271 A92-10479

Vortex lattice-vortex liquid states in anisotropic high-(T
sub c) superconductors [PB92-142421] p 273 A92-22738

Mutual friction in superfluid He-3: Effects of bound states
in the vortex core [PB92-142231] p 197 A92-26507

Exotic states in the cores of quantized vortices for
superfluids and superconductors [DE92-728466] p 206 A92-70151

SALT, DAVE

Manned missions to Mars - What scenarios for
Europe? [IAF PAPER 92-0534] p 121 A92-55842

SALT, DAVID J.

Anane Transfer Vehicle (ATV) - A generic spacecraft
[IAF PAPER 91-186] p 126 A92-12560

SALVA, J. J.

Gravitational effects on flame spreading over thin
cylindrical fuel samples p 147 A92-14020

SALVATORE, A.

Prediction of aerodynamic phenomena limiting aircraft
manoeuvrability p 80 A92-18781

SAMANIEGO, J. M.

The coherent flamelet model for propulsion
applications p 147 A92-27486

SAMBLANCAT, CHRISTIANE

Double loop control law strategy and applications to
helicopter [CERT-2/7724-DERA] p 108 A92-19295

SANCHEZ, F.

Fuzzy guidance system evaluation p 259 A92-27903

SANCHEZ, FRANCISCO

Planetary vision as a strategy p 229 A92-25243

- SANCHEZ, LUIS M.**
Madrid's double airport p 110 A92-16231
- SANDELL, HAAKAN**
Tasks of the council and general secretary of the Commission for Space Industry (Finland) p 276 N92-25785
- SANDERS, N. J.**
Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- SANDVEN, STEIN**
Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943
- SANSONE, A.**
CARINA - A space vehicle with re-entry capabilities for microgravity experiments [IAF PAPER 92-0816] p 133 A92-57214
Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 N92-14980
- SANTANGELO, P.**
A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
- SANTI, FRANCOISE**
A simplified model for aerodynamic flows around streamlined models p 6 A92-13816
- SANTILLAN, S.**
Vortical flow simulation by using structured and unstructured grids p 30 N92-12999
- SANTINI, P.**
Gust effects on a flexible aircraft p 68 A92-22474
- SANTOS, DANIEL**
Fatigue management for the A-7P p 79 N92-18593
- SANZ, A.**
Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
- SAOUAB, A.**
Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- SAOUAB, ABDELGHANI**
Application of a variational method in compressible flow computations p 179 A92-47070
- SAPIN, S.**
Compressibility effects in turbulent far wakes p 18 A92-40140
- SAPORITI, A.**
Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
- SARGENT, W. L. W.**
Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- SARLO, LORENZO**
Software management strategies and practices for space systems development p 258 N92-20610
- SARRON, J. C.**
G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
- SATCHELL, J. S.**
High temperature superconducting vortex flow transistor p 159 A92-38971
- SATTA, A.**
Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- SAUCRAY, J. M.**
International standardisation of regulations for gust loading calculations p 68 A92-22473
- SAUNDERS, R. W.**
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771
Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- SAUSEN, T. M.**
Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- SAUVINET, F.**
Explicit guidance law for manned spacecraft [AIAA PAPER 92-1145] p 123 A92-33286
- SAVAGE, J. A.**
The near millimetre wavelength optical constants of calcium lanthanum sulphide p 272 A92-52965
- SAVILL, A. M.**
Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
- SAVINI, M.**
Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes [ASME PAPER 91-GT-312] p 8 A92-15689
- SAVORY, E.**
Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
- SAVU, G.**
On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266
- SAVULESCU, N.**
Organized structures in the developing region of axis-symmetric jet flow p 182 A92-51892
- SAWLEY, M. L.**
Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551
- SAX, H.**
Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370
- SAXTON, J. M.**
Oxygen isotopes implanted in the LDEF spacecraft p 272 N92-27284
- SCHAFFAR, LAURENCE**
Effects of long duration spaceflight on human T lymphocyte and monocyte activity p 245 A92-15956
- SCHAFRANEK, D.**
Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
- SCHARROO, R.**
Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949
- SCHENK, H.-D.**
Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
- SCHERRER, DOMINIQUE**
Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies [AIAA PAPER 91-5039] p 94 A92-17827
- SCHERTZER, D.**
Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461
- SCHERTZER, DANIEL**
Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
- SCHETTINO, ANTONIO**
High enthalpy nozzle flows p 36 N92-15000
Influence of chemical modelling on hypersonic flow p 37 N92-15015
- SCHUEERER, GEORG**
Numerical prediction of boundary layers and transitional flows p 196 N92-24342
- SCHUEURER, B.**
Some direct methods in electromagnetism p 265 A92-47921
- SCHIAVON, G.**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- SCHICK, FRED V.**
The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041
Evaluation of the COMPAS experimental system p 63 N92-19044
Evaluation of the COMPAS operational system p 63 N92-19047
- SCHIERENBECK, D.**
Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 N92-23238
- SCHIETECATTE, B.**
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
- SCHIJVE, J.**
Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045
- SCHILLING, HARTMUT**
Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155
- SCHLINGELHOF, MARIUS**
The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 N92-10997
- SCHMAELZLE, U.**
Methodology for assessment of skin repairs on Airbus aircraft p 219 N92-14428
- SCHMATZ, M.**
Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 N92-22180
Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 N92-22181
Case 7.4 delta wing: Navier-Stokes calculation p 42 N92-22182
- SCHMATZ, M. A.**
Verification and application of the NSFLEX method for hypersonic flow conditions p 36 N92-15005
- SCHMIDT, G.**
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
- SCHMIDT, HANS-J.**
Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- SCHMITT, F.**
Empirical determination of universal multifractal exponents in turbulent velocity fields p 165 A92-21461
- SCHMITT, FRANCOIS**
Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
- SCHMUGGE, T. J.**
Spectral emissivity variations observed in airborne surface temperature measurements p 221 A92-17124
- SCHMUGGE, THOMAS**
TIMS calibration correction by comparison with PRT5 p 223 N92-11412
- SCHNEIDER, G.**
First approach to an integrated fin design p 83 N92-23236
- SCHOCK, H. W.**
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- SCHOENE, J.**
Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 N92-14977
Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
- SCHOENMAEKERS, J.**
Cluster: Fuel optimum spacecraft formation control p 122 N92-24777
- SCHOENUNG, BERNHARD E.**
Numerical fluid mechanics - Incompressible flows with complex boundaries [ISBN 3-540-53137-8] p 169 A92-29649
- SCHOEPFEL, A.**
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] p 219 N92-14397
- SCHOETLE, ULRICH M.**
Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645
- SCHOLTEN, FRANK**
Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691
- SCHORTER, M.**
Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468
- SCHRA, L.**
Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 N92-28850
Short cracks and durability analysis of the Fokker 100 wing/fuselage structure [NLR-TP-90336-U] p 220 N92-29603
Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307
- SCHRAGE, D. P.**
Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302
- SCHREIER, F.**
Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
- SCHREYER, H.**
Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
- SCHROEDER, W.**
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703
- SCHUBERT, M.**
COMPAS system concept p 63 N92-19043
Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905
- SCHUELLER, ANTON**
Parallel and vector aspects of a multigrid Navier-Stokes solver [PB91-232868] p 260 N92-16645
- SCHUHMACHER, G.**
Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- SCHULKES, R. M. S.**
Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704

SCHULTE-WERNING, BURKHARD

On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

SCHULTE, G.

Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208

SCHULTZ, KLAUS-J.

BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344

SCHULTZ, P.

Testing of an experimental photographic reconnaissance system p 209 N92-25602

SCHULZE, B.

Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304

Computation of flutter boundaries in the time and frequency domain p 46 N92-27952

SCHUMANN, U.

Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054

SCHUMANN, ULRICH

Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329

SCHUSTER, JOACHIM

The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 N92-31813

SCHUSTER, TH.

Observation of inverse domains in high Tc superconductors p 273 A92-52211

SCHWARZMANN, L.

A concept for the revisions of structural inspection schedules p 215 N92-14431

SCHWARTE, A.

Code generation for fast DSP-based real-time control p 257 N92-12462

SCHWARTEN, H.

Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951

SCHWARTZ, F.

The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760

SCHWARZENBERGER, P. M.

The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

SCHWEITZER, G.

Control concepts for active magnetic bearings p 214 N92-27743

SCHWENDE, M. A.

Bi-propellant thruster family for spacecraft propulsion [AIAA PAPER 92-3860] p 141 A92-54208

SCHWINGSHAKL, G.

Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473

SCOTT, N. A.

Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034

SCRIVENER, C. T. J.

Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 N92-20179

SCULL, S.

A heat switch for space cryocooler applications p 160 N92-25852

SCULL, S. R.

Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851

SCURLOCK, R. G.

Magnetic suspension using high temperature superconducting cores p 161 N92-27789

SEATON, B.

Operational aspects of spacecraft autonomy p 131 A92-24207

SEBAG, SAMUEL

Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 N92-32725

SECRETAN, Y.

Mikado: A graphic program p 190 N92-16237

SEDBON, GILBERT

Mirage 2000-5 - Dassault's delta described p 67 A92-16622

SEEL, M. W. R.

The other missiles p 2 A92-28184

The application of high pressure ejectors to reaction control systems p 93 A92-16666

SEELEY, JOHN S.

Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108

SEIDEL, A.

High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249

SELCON, S. J.

Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131

SELCON, STEPHEN J.

Decision support in the cockpit - Probably a good thing? p 251 A92-11135

SELLAR, M. R.

Re-engineering for real stage 3 compliance [PNR-90872] p 102 N92-33748

SELLIER, ANTOINE

An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows p 164 A92-20724

SELMIN, V.

Simulation of hypersonic flows on unstructured grids p 15 A92-31496

Vortical flow simulation by using structured and unstructured grids p 30 N92-12999

SEMPLE, W. G.

Development of tactical decision aids p 90 N92-12532

SENCHENKOV, A. S.

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

SENGUPTA, JAY R.

Inmarsat aeronautical mobile satellite system: Internetworking issues p 158 N92-24098

SENS, ANNE-SOPHIE

Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 N92-30514

SENSBURG, O.

Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650

SENSBURG, OTTO

Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474

SEPFERS, A. K.

Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155

SERAFIMOV, K. B.

Use of natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644

SERAFIN, D.

Lightning strike simulation using coaxial line technique and 3D linear injection current analysis p 159 A92-20131

SERGATSKOV, D. A.

Vortex nucleation in rotating superfluid He-3-B p 271 N92-10476

SERR, CHRISTOPHE

Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398

SETTELS, J. J.

Control of blood pressure in humans under microgravity p 248 N92-23071

SETTIMO, FRANCO

Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 N92-30941

SEUBERT, R.

Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693

SHAHPAR, S.

Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow [AERO-REPT-9007] p 40 N92-18231

Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate [AERO-REPT-9008] p 40 N92-18232

SHASHKOV, MIKHAIL Y.

Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767

SHAW, C. T.

Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289

SHAW, G. J.

Cell vertex finite volume discretizations in three dimensions p 168 A92-27475

SHAW, J. A.

The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089

SHAW, K. B.

Radiation exposure of aircrew p 246 A92-16409

SHEN, WHEN-ZHONG

Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466

SHIPPEN, J. M.

Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547

SHOPOV, A. V.

Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958

SHUCHMAN, R. A.

Comparison of aircraft synthetic aperture radar and buoy spectra during NORCSEX '88 p 242 A92-34878

SICKINGER, P.

Crystal growth experiments on Russian unmanned spacecraft [IAF PAPER 92-0934] p 151 A92-57307

SIDEN, L. D. G.

Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625

SIDES, J.

Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method [ONERA, TP NO. 1991-177] p 10 A92-16139

SIEGWART, ROLAND

Control concepts for active magnetic bearings p 214 N92-27743

SIEPMANN, R.

Two-phase thermal technology for space application: Development status p 138 N92-25834

SIGURDSSON, G.

Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 N92-18574

SIKONEN, T.

Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations [PB92-136449] p 42 N92-21784

SILLI, TERO

International Space University: Experiences and observations during Summer 1989 p 275 N92-25786

Space electronic display panel p 278 N92-25787

SILVA, A.

Control strategies for space systems p 137 N92-24494

SILVESTRI, P. L.

Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs p 136 N92-24493

SIMANDIRAKIS, G.

Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533

SIMEONIDES, G.

Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321

Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 N92-14991

SIMEONOVA, I. U. M.

Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958

SIMMET, GEORG

Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347

SIMON, A.

Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764

SIMON, F. J.

Investigation of the tail buffeting of the C-101 p 26 A92-53253

SIMONI, M.

Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350

SIMONIN, O.

Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089

SIMONS, M.

Radiation exposure of civil air carrier crewmembers [NLRGCB-1-4/91] p 249 N92-33908

SIMONSSON, BENGT

Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087

SINGER, A. C. B.

Tomorrow's cockpit displays p 88 A92-13699

SINGER, B.

RAE Bedford VAAC research project p 104 A92-40039

- SIROU, F.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- SITT, B.**
Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
- SIVAKUMAR, M. V. K.**
Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198
- SKJONG, R.**
Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 A92-18574
- SKODA, ZDENEK**
Application of holomorphic vectors theory in three-dimensional potential flow problem p 165 A92-21923
Effect of a deicing device on the induced drag of a lifting airfoil p 74 A92-35047
- SKOE, IVAR HELGE**
A PC-based inverse design method for radial and mixed flow turbomachinery p 97 A92-13943
- SKEELV, AAGE**
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 A92-12157
- SKEELV, AGE**
Simulations of SAR imaging of ship wakes, comparing different wind growth rate models p 242 A92-35025
- SLAUERHOFF, J. F.**
Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
- SMART, K. P. R.**
Learning from aircraft accidents and incidents p 54 A92-39310
- SMIRRA, K.**
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 A92-20249
- SMIT, J.**
G-tolerance and spatial disorientation: Can simulation help us? p 248 A92-28534
- SMITH, A. G.**
The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
- SMITH, A. J.**
Approach and landing guidance p 65 A92-21960
- SMITH, A. J. D.**
The dynamic response of separated hypersonic flows p 38 A92-15019
- SMITH, E. J.**
Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412
- SMITH, F. T.**
Steady and unsteady 3D interactive boundary layers p 161 A92-10689
Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228
- SMITH, G. H.**
Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- SMITH, I. M.**
The e-beam sustained laser technology for space-based Doppler wind lidar p 240 A92-29300
- SMITH, J.**
Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TR-88072-U] p 49 A92-29884
Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 A92-32734
- SMITH, J. H. B.**
Asymmetric vortex flow over circular cones p 32 A92-13014
Vortex flow aerodynamics [AGARD-AR-299] p 50 A92-30947
- SMITH, KEITH**
Aeronautical satellite system test and implementation p 158 A92-24095
- SMITH, M. J. T.**
Do we really need 57 ways of rating aircraft noise? p 227 A92-39065
Re-engining appears to offer best payback for young: Chapter 2 compliant aircraft [PNR-90848] p 98 A92-19939
The impact of aircraft noise control technology [PNR-90846] p 269 A92-20461
The environmental challenges for the next supersonic aircraft [PNR-90782] p 228 A92-20928
- Environmentally sound [PNR-90776] p 228 A92-21743
- SMITH, P. R.**
Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 A92-12004
- SMITH, PETER H.**
The requirements and management of quality audits and reviews [PNR-90840] p 275 A92-20458
- SMITH, RICHARD B.**
Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322
- SMITH, ROGER K.**
The stability of barotropic vortices: Implications for tropical cyclone motion p 240 A92-26335
- SMOUT, P. D.**
The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation [PNR-90791] p 194 A92-22099
- SNAPE, D. M.**
Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 A92-21740
The impact of air transport on the environment [PNR-90876] p 230 A92-33751
- SNEE, J. M. D.**
Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 A92-23238
- SNOEIJ, P.**
First results from the Netherlands SAR testbed 'PHARS' p 221 A92-34903
- SOBIECZYK, H.**
Extended mapping and characteristics techniques for inverse aerodynamic design p 76 A92-13949
- SODDU, C.**
LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468
GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 A92-24443
- SOELTER, HARALD**
A multivariable control concept for a gas turbine engine [ETN-92-92104] p 102 A92-33645
- SOESMAN, J. L.**
On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 A92-29703
- SOININEN, P. I.**
Superfluid vortex nucleation in He-3 flow p 271 A92-10479
- SOIZE, C.**
Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 A92-32776
- SOLAZZO, M.**
Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980
- SOLIGNAC, J. L.**
Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 A92-11308
- SOLIMINI, D.**
Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
- SOLIN, JUSSI**
Fatigue life analysis for variable-amplitude loading p 218 A92-19697
- SOLLO, ANTONIO**
Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 A92-32956
- SOLOMON, S.**
Homogeneous and heterogeneous chemistry along air parcel trajectories p 232 A92-14541
- SOLOVJOV, ANDREY V.**
Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 A92-32767
- SOMMER, MICHAEL**
The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 A92-27049
- SOMMERIA, J.**
Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
- SONIN, E. B.**
Vortex motion in rotating superfluid He-3-B [PB92-134162] p 194 A92-21763
- Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 A92-21773
- SOTIAUX, V.**
CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185
- SOULEZ-LARIVIERE, C.**
ESA data linkage process through the example of manned spacecraft atmospheres p 253 A92-25842
- SOUTHWOOD, D. J.**
Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271
Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412
- SOUZA, KENNETH A.**
Gravity effects on reproduction, development, and aging p 244 A92-34193
- SOWTER, A.**
Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients p 123 A92-15818
- SOWTER, ANDREW**
Drag coefficients with applications to satellite orbits p 133 A92-11069
- SPASOV, A. IA.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- SPASOVA, T. S.**
A theoretical test of the geostrophic momentum approximation p 237 A92-39471
- SPECTER, C. N.**
Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
- SPEKREIJSE, S. P.**
The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations [AIAA PAPER 92-2619] p 256 A92-45492
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 A92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 A92-14326
Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 A92-24411
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 A92-32730
- SPEKREIJSE, S. P.**
An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079
- SPELTEN, ROBERT**
Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements [ETN-92-91492] p 49 A92-29889
- SPENCER, A.**
Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667
- SPIEGEL, E. A.**
Vortices on accretion disks p 284 A92-27396
Convection-induced shears for general planforms p 177 A92-44352
- SPIEGEL, P.**
Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction [ONERA-RS-97/5094-PY] p 269 A92-21736
- SPIEGEL, PIERRE**
Theoretical study and prediction of BVI noise including close interactions [ONERA, TP NO. 1991-174] p 265 A92-16138
- SPIEKHOUT, D. J.**
Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device p 78 A92-18583
- SPILLING, P. D.**
Modelling of aerospace materials - Not just a pretty picture p 212 A92-33363
- SPILLMAN, J. J.**
The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096
- SPIRKL, A.**
'A new proposal for an old problem' - The right engine for the right helicopter p 96 A92-56281

- SPITALERI, R. M.**
Multigrid grid generation in scalar and parallel environments p 256 A92-47084
- SPLETTSTOESSER, WOLF R.**
BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- SPRUCK, J.**
Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 N92-21788
- SPRUJIT, H.**
ESA power standard p 141 N92-13174
- SPURGEON, S. K.**
An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
- SQUEGLIA, G.**
International standardisation of regulations for gust loading calculations p 68 A92-22473
- SQUIRE, C.**
A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55 p 14 A92-28006
- SRINIVASAN, S.**
Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
- SRINIVASAN, SHIVAKUMAR**
Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168
- STAEHLE, ROBERT L.**
Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
- STAMATIS, A.**
Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
- STANISLAS, M.**
Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55] p 187 N92-12216
- STAQUET, C.**
Final equilibrium state of a two-dimensional shear layer p 164 A92-19967
- STARK, J. P. W.**
Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- STARK, JOHN P. W.**
Spacecraft systems engineering [ISBN 0-471-92794-5] p 120 A92-33401
The space environment and its effects on spacecraft design p 120 A92-33403
- STATECNY, JIRI**
Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950
- STAUFENBIEL, R.**
On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
- STAVRAKAKIS, G. S.**
Computation of aircraft geometric height under radar surveillance p 61 A92-40239
- STECCO, S. S.**
Transonic cascade flow prediction using the Navier-Stokes equations [ASME PAPER 91-GT-313] p 8 A92-15690
- STECKEMETZ, B.**
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
- STEIDEL, C. C.**
Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- STEINBACH, DIETER**
Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
- STEINMETZ, P.**
Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
- STENBERG, ROLF**
Stabilized finite element methods for the Stokes problem [PB92-142298] p 263 N92-24963
- STEPHENSON, C. A.**
The dynamics of the Cluster spacecraft p 137 N92-24510
- STEVE, HERVE**
Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157
- STEVENS, E. G.**
Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134
- STEVENS, J. E.**
Aircraft fatigue management in the Royal Air Force p 79 N92-18591
- STEVENSON, T. N.**
Physical and computational modelling of stratified shear flows [AERO-REPT-8909] p 190 N92-17974
Modelling of interfacial and thermocline waves [AERO-REPT-9006] p 243 N92-18089
Modelling of interfacial and thermocline waves [AERO-REPT-9011] p 243 N92-18234
- STEWART, R. J.**
A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026
- STIELER, BERNHARD**
Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600
Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601
- STIFT, M. J.**
Modelling stellar surface magnetic fields. I - Search strategies and uniqueness p 283 A92-14147
- STOCK, H.**
Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
- STOJANOFF, C. G.**
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- STOLCIS, LUCA**
Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions [AIAA PAPER 92-2638] p 20 A92-45507
- STOLL, MAGALI**
TIMS calibration correction by comparison with PRT5 p 223 N92-11412
- STOLLERY, J. L.**
Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing [CRANFIELD-AERO-9113-PT-1] p 40 N92-19679
- STOLZE, DETLEF**
The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 N92-10997
- STORNELLI, S.**
Control strategies for space systems p 137 N92-24494
- STOTT, G.**
Evolution of ASTOVL aircraft design p 72 A92-45311
- STOUFF, C.**
Vigilance of aircrews during long-haul flights p 247 A92-45021
- STOURBE, Y.**
Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- STOW, PETER**
An unfactored implicit scheme for 3D inviscid transonic flows [AIAA PAPER 92-2668] p 20 A92-45523
- STRAUCH, H.**
Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
- STRAZZULLO, FRANCO**
Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
- STREBY, OLIVIER**
BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- STREET, A. B.**
VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306
VSTOL engine design evolution: Growth of the Pegasus engine for Harrier [PNR-90805] p 99 N92-27039
- STREET, C. A. C.**
Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384
- STREICHER, J.**
Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
Trial of a slant visual range measuring device p 210 N92-31043
Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- STREIT, T.**
Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
- STRINGER, S. J.**
Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034
- STRUCKMEIER, J.**
Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734
Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
- STRIJIS, R.**
Multidimensional upwind methods for unstructured grids p 201 N92-27675
- STUBERT, B.**
Computation and visualization of specific flow phenomena in turbomachinery application p 100 N92-27463
- STUBOS, A. K.**
Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 N92-21237
- STUELPNAGEL, JOHN C.**
Implications of interoperability and standardization for the industrial base p 92 N92-14057
- SUDMEIJER, K. J.**
LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983
- SULEIMAN, A.**
Integrated heat pipe concept for Li/SOC12 cells cooling p 160 N92-26974
- SULLIVAN, P.**
Compressibility effects in turbulent far wakes p 18 A92-40140
- SUMMERFIELD, P. H.**
36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941
- SUN, JIONG**
Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347
- SUND, A. T.**
Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
- SUOKAS, J.**
Quality assurance of safety and risk analysis p 215 N92-18629
- SUPPER, W.**
Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- SUSKI, HARALD**
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382
- SVANE, CHRISTIAN**
DANSIM - Danish Airport Noise Simulation Model - Basic principles, experience, and improvements p 227 A92-39055
DANSIM applications - Development of airport noise reduction strategies and environmental policy p 227 A92-39057
- SVEC, O. J.**
Heat pump systems with direct expansion ground coils [DE92-007831] p 195 N92-23120
- SVERDRUP, HARALD U.**
Spinal X-ray screening of high performance fighter pilots p 245 A92-15959
- SWADZBA, L.**
Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- SWALE, R.**
Cost effective solutions for titanium sheet metal forming p 211 A92-22785
- SWALE, W.**
Cost effective solutions for titanium sheet metal forming p 211 A92-22785
- SWANBOROUGH, GORDON**
Dornier 328 - A Daimler for commuters p 69 A92-30091
- SWARBRICK, SEAN JAMES**
Finite element simulation of viscoelastic flow p 205 N92-34038
- SWEETMAN, BILL**
Infra-red offers new landing aid competition p 88 A92-18937
Why composites wait in the wings p 144 A92-35475
Procurement doubts threaten research p 275 A92-47974

- SWIDER, ANDRZEJ**
Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia p 217 A92-12346
- SWINYARD, BRUCE M.**
Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
- SWIRSKI, KONRAD**
Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791
- SYLVESTRE-BARON, ANNICK**
Normalization, reliability and validation of information for spatial operations p 157 A92-15285
- SYTSMAN, H. A.**
Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477
- SZALAI, KENNETH J.**
Validation of flight critical control systems [AGARD-AR-274] p 108 A92-20026
- SZEPESSY, ANDERS**
A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
- SZMELTER, J.**
Mesh adaptivity with the quadtree method p 22 A92-47041
Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- SZUSZKIEWICZ, E.**
Vortices on accretion disks p 284 A92-27396
- T**
- TA, PHUOC L.**
Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation [ONERA, TP NO. 1991-235] p 168 A92-26386
- TABUOYA, IGNACIO G.**
Iberia's Aeronautical Mapping Application (ACAI) p 60 A92-37073
- TAHOURI, B.**
Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858
- TAMPIERI, F.**
Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093
- TAN, S. C.**
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 A92-20573
- TANNER, M.**
Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 A92-14992
- TANSKANEN, P.**
CAPS-plasma spectrometer for the Cassini spacecraft p 140 A92-10565
- TANSKANEN, PEKKA**
Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 A92-25758
- TARDITI, S.**
Vortical flow simulation by using structured and unstructured grids p 30 A92-12999
- TARRIEU, C.**
Aerostat for the Mars 1994/1996 mission p 285 A92-24642
- TARTARIN, J.**
Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
- TARTTELIN, P. C.**
Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme p 70 A92-35767
- TATNALL, A. R. L.**
Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
- TATTERSALL, P.**
Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318
- TAYLOR, B. S.**
Using Rankine vortices to model flow around a body of revolution p 169 A92-28061
- TAYLOR, F. W.**
The Venusian polar dipole p 285 A92-30456
- TAYLOR, P. K.**
Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 A92-29213
- TAYLOR, R. M.**
Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
- TEGTMEIER, A.**
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 A92-15017
- TELEDASILVA, A. F.**
Applications of boundary integral methods to the study of steep free surface waves p 195 A92-23149
- TEMNYI, V. V.**
A method for determining the potential of a spacecraft p 131 A92-23433
- TENAUD, C.**
Hypersonic wakes [ETN-92-91082] p 41 A92-19925
- TENDAM, A. A.**
Development environment for digital manipulator simulators [PB91-222190] p 213 A92-16313
- TENHAVE, J. M.**
NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 A92-29204
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 A92-29605
- TENSI, J.**
Instantaneous visualization of surface flows p 207 A92-44327
- TERLIZZI, A.**
Numerical computations of transonic flows through cascades [AIAA PAPER 92-3041] p 24 A92-48702
- TERRIBLE, A.**
In-orbit experiment of object capture technology [IAF PAPER 91-002] p 251 A92-12427
- TETZLAFF, JUERGEN**
Arrangements and methods for the survey of aircraft radio components and systems p 92 A92-25603
- THART, W. G. J.**
Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 A92-28850
Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 A92-70307
- THAYER, RICHARD H.**
Requirements p 255 A92-19382
- THEILLIER, FRANCIS**
Ariane Transfer Vehicle (ATV) - A generic spacecraft [IAF PAPER 91-186] p 126 A92-12560
Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- THERY, CHRISTIAN**
The sonic boom and problems related to supersonic flights of military aircraft [ONERA, TP NO. 1991-162] p 9 A92-16129
- THEUNS, T.**
Spherically symmetric, polytropic flow p 284 A92-20810
- THEVENOT, REGIS**
STS 2000 - A reference airbreathing SSTO [AIAA PAPER 91-5013] p 126 A92-17811
Control of the destruction of a logistic vehicle at reentry p 126 A92-20778
- THIBERT, J. J.**
The A320 laminar fin programme [ONERA, TP NO. 1992-23] p 73 A92-48586
Drag prediction using computation methods [ONERA-RSF-82/1685-AY-154-4] p 41 A92-19682
- THIVET, F.**
Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
- THOMADAKIS, M. P.**
Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546
- THOMAS, M. D.**
The nonlinear stability of flows over compliant walls p 179 A92-46265
- THOMAS, P.**
Status and user characterization of parallel machines for digital simulation p 260 A92-23046
- THOMPSON, D.**
Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 A92-23233
- THOMPSON, HAYDN ASHLEY**
Parallel processing applications for gas turbine engine control p 96 A92-11012
- THOMPSON, R. S.**
Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCs p 136 A92-24493
- THOMSON, D. G.**
The use of inverse simulation for conceptual design p 70 A92-35738
- THORPE, ALAN J.**
Mesoscale dynamics of cold fronts - Structures described by dropsoundings in Fronts 87 p 235 A92-18902
The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
- THUNEBERG, E. V.**
Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 A92-22788
- TICHTINSKY, HELENE**
Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models [ONERA, TP NO. 1991-110] p 163 A92-16089
Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 A92-27490
- TIGOIU, V.**
A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891
- TILLBERG, ERIK**
Swedish user support for Columbus p 120 A92-32469
- TIMSIT, C. A.**
Problems experienced by man when constructing giant structures in space p 251 A92-40438
- TOCKERT, CHRISTIAN**
The concept of a long duration stratospheric balloon p 43 A92-24645
- TOFANI, ALESSANDRO**
Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392
- TOGHI, F.**
Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745
- TOGNACCINI, R.**
Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 A92-28712
- TOMAS, A.**
Study on the requirements for the installation of a CES and habitability centre p 254 A92-27007
- TOMATIS, ANNE**
Ground operations of a HTOL airbreathing launcher [IAF PAPER 91-217] p 125 A92-14708
- TOMBS, MICHAEL STANLEY**
Robust control system design with application to high performance helicopters p 108 A92-19621
- TOMLINSON, B. N.**
Initial validation of a R/D simulator with large amplitude motion p 116 A92-28546
- TOOGOOD, R. D.**
Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 A92-21693
- TORELLA, GIOVANNI**
Expert systems for the trouble-shooting and the diagnostics of engines [AIAA PAPER 92-3327] p 260 A92-48910
The numerical simulation of the main fuel control unit of gas turbine engines [AIAA PAPER 92-3760] p 96 A92-49115
- TORIZUKA, K.**
Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 A92-21773
Ultrasonic investigation of (3)He-A vortices in low magnetic fields [PB92-142256] p 265 A92-23665
- TORKAR, K. M.**
Balloons for conjugate cusp studies in the 1990's p 233 A92-26315
- TORLUND, PER-AKE**
Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 A92-18786
- TORO, E. F.**
Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 A92-19916
- TORQUATI, FRANCO**
A constraint satisfaction approach to operative management of aircraft routing p 54 A92-25181
- TORRES, O.**
Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone p 231 A92-54645

TORSTENSSON, BO

Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779

TOSI, S.

Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 A92-24474

TOULMAY, FRANCOIS

Lifting line predictions for a swept tip rotor blade p 7 A92-14424

TOURNEMINE, G.

Concerning the functional solution of transonic flows p 11 A92-21318

TOUSSAINT, Y.

Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764

TOWERS, C. E.

A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825

TOWERS, D. P.

A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136
The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825

TOWNEND, L. H.

Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691

TOWNSEND, P.

The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445

TOY, N.

Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multielement airfoil p 16 A92-38858

TRAN, D.

G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 A92-18984

TRAXLER, ALFONS

Control concepts for active magnetic bearings p 214 A92-27743

TRITTON, D. J.

The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488

TROCHALIDIS, V.

The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refueling p 103 A92-13199

TROCHALIDIS, VASSILIOS

Aircraft aerodynamics and stability and control during air-to-air refueling [AERO-REPT-9017] p 107 A92-18321

TROMBETTI, F.

Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093

TROMEUR-DEROVOUT, D.

Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation [ONERA, TP NO. 1991-235] p 168 A92-26386

TROUSSET, A.

Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 A92-19926

TROUVE, MICHEL

Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor p 67 A92-14398

TRUBSHAW, E. B.

Concorde flight testing - Powerplant and performance flying [SAE PAPER 912192] p 72 A92-40009

TRUSCOTT, P. R.

Surface activation of Concorde by Be-7 p 271 A92-23295

TSAMOURTZIS, V.

Quasi-three-dimensional characteristics method for a supersonic compressor rotor [ASME PAPER 91-GT-81] p 7 A92-15549

TSANGARIS, S.

Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies [AIAA PAPER 92-2704] p 21 A92-45546

TSCHIEGG, E.

Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615

TSELEPIDAKIS, D. P.

Progress and paradoxes in modelling near-wall turbulence p 174 A92-40158

TSINOBER, A.

Helicity in laminar and turbulent flow p 177 A92-45089

TU, J. Y.

Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599

TUBANOS, N.

The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 A92-15009

TUBBS, H.

Compressing the compressor [PNR-90824] p 99 A92-21848

TUNNICLIFFE, PETER A.

An investigation of cold overflow over the Iceland/Faeroes Ridge [AD-A243084] p 242 A92-17169

TURCAT, A.

The turbo-ramjet Griffon p 286 A92-41820

TURNER, G.

Oxygen isotopes implanted in the LDEF spacecraft p 272 A92-27284

TURNER, J.

A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489

TURNER, JOHN

Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490

TURNER, RAYMOND F.

Spacecraft structures p 132 A92-33410

TURTON, JOHN A.

Avionics software evolution p 91 A92-14052

TUSZYNSKI, MICHAL

Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293

TVALASHVILI, G. K.

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 [PB92-134147] p 269 A92-21773

TVEITEREID, M.

Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963

TYSELL, LARS G.

MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 A92-20468

MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document [FFA-TN-1990-20] p 50 A92-30713

U

UBALDI, MARINA

Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861

UECKER, ARWED R.

The stability of graphite brushes at high velocity [ETN-91-90176] p 160 A92-12184

UMETANI, YOJI

Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704

UTZ, H.

Safety and mission capabilities of manned launch vehicles [IAF PAPER 92-0383] p 128 A92-57370

V

V. D. EMDE, K.

Solving conservation laws with parabolic and cubic splines p 262 A92-27737

V. BOEHM, H.-D.

Passive optical and IR sensors [MBB-UH-HE512] p 224 A92-23392

VALDES, L.-C.

Calculation of noise generated in flows on the basis of an aerodynamic/acoustic decomposition [ONERA, TP NO. 1992-35] p 267 A92-48596

VALENTIN, R.

Airborne lidar and radiometric observations of PBL- and low clouds p 240 A92-31037

VALISENA, N.

Reliability modeling for non-electronic systems p 216 A92-18633

VALORANI, M.

Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737

VALOT, CLAUDE

Knowledge transfer and support systems in fighter aircraft p 251 A92-45047

VAN DEN ABELEN, LUCIEN

Soviet space at the crossroads p 118 A92-11881

VAN DEN BERG, J. I.

Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477

VAN DEN BROEK, P. PH.

Modelling and identification of flexible spacecraft p 131 A92-15409

VAN DER GEEST, P. J.

A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172

VAN DER HAGE, J. C. H.

Interpretation of field measurements made with a portable albedometer p 207 A92-49773

VAN DER KLEIN, D. C. M.

Quantitative estimation of secondary surveillance radar information p 59 A92-24943

VAN DER MAAREL, ERIC

Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822

VAN DER VEEN, S. H.

A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994

VAN DER VOOREN, J.

Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212

VAN DER WEES, A. J.

Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212

VAN DRIEL, NICO

Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928

VAN HEIJST, G. J. F.

Spin-up in a semicircular cylinder p 184 A92-56123

VAN HEIJST, GERTJAN F.

Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990

VAN MIERLO, TOM I. M.

Dutch security rights in aircraft and engines p 280 A92-35594

VAN MUYLEN, ALAIN

Rib cage shape and motion in microgravity p 247 A92-56944

VAN NUNEN, J. W. G.

LAH main rotor model test at the DNW p 70 A92-35771

VAN SON, P. C.

Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897

VAN VEGGEL, L. H.

The evolution from bonded F27 aircraft to Arall structures p 3 A92-41177

VANDEFLIET, B. W.

Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 A92-29977

VANDENBERG, J. I.

Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 A92-13000

Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds [NLR-TP-90029-U] p 41 A92-20498

Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 A92-28657

Development and validation of a characteristic boundary condition for a cell-centered Euler method [NLR-TP-90144-U] p 47 A92-28692

VANDENBRAEMBUSSCHE, R. A.

Blade design and analysis using a modified Euler solver p 97 A92-13952

VANDENDAM, R. F.

Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-89126-U] p 47 A92-28660

SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 A92-70249

VANDERBERG, B.

Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects [NLR-TP-90184-U] p 201 A92-28694

- VANDERBURG, J. W.**
Improved shock-capturing of Jameson's scheme for the Euler equations
[PB92-148758] p 196 N92-23251
- VANDERVOOREN, J.**
Inviscid drag prediction for transonic transport wings using a full-potential method
[NLR-TP-89365-U] p 41 N92-20473
Wave drag determination in the transonic full-potential flow code MATRICS
[NLR-TP-90062-U] p 47 N92-28709
- VANDERWEES, A. J.**
Inviscid drag prediction for transonic transport wings using a full-potential method
[NLR-TP-89365-U] p 41 N92-20473
Wave drag determination in the transonic full-potential flow code MATRICS
[NLR-TP-90062-U] p 47 N92-28709
- VANDERZANT, HERRE SJOERD JAN**
Vortex dynamics in artificially fabricated superconducting networks
[ETN-92-91296] p 160 N92-25307
- VANDROMME, D.**
Structure and modelling in strongly sheared turbulent compressible flow
p 175 A92-40161
- VANDROMME, DANY**
Application of a variational method in compressible flow computations
p 179 A92-47070
Marco contract report
[ETN-92-91077] p 193 N92-20232
- VANEGELEN, J. A. J.**
Some longitudinal handling qualities design guidelines for active control technology transport aircraft
[NLR-TP-90129-U] p 109 N92-28652
Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft
[NLR-MP-88044-U] p 87 N92-29616
- VANGROESEN, E. W. C.**
Monopolar vortices as relative equilibria and their dissipative decay
[MEMO-1015] p 202 N92-29977
- VANHEMEL, PAUL E.**
The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations
p 116 N92-28539
- VANHENGST, J.**
The effect of hoar-frosted wings on the Fokker 50 take-off characteristics
p 56 N92-21692
- VANKEIRSBLICK, P.**
Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes
p 201 N92-27678
- VANKLEEF, E. R. A.**
Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532
- VANKUIK, GJSBERTUS ARNOLDUS MARIA**
On the limitations of Froude's actuator disc concept
[ETN-91-90136] p 29 N92-11973
- VANLEEUWEN, M.**
Control of blood pressure in humans under microgravity
p 248 N92-23071
- VANN, F. W.**
Aircraft structural design
p 72 A92-39304
- VANNIER, JEAN-CLAUDE**
Is the avionics system of the Hermes Spaceplane centralized or decentralized?
p 139 A92-49258
- VANNUNEN, J. W. G.**
LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
- VANOOST, S.**
A heat switch for space cryocooler applications
p 160 N92-25852
- VANPATTEN, ROBERT E.**
G-tolerance and spatial disorientation: Can simulation help us?
p 248 N92-28534
- VANSWOL, R. W.**
CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration
[NLR-TP-89103-U] p 225 N92-29707
- VANWOERKOM, P. T. L. M.**
Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators
[NLR-TP-90028-U] p 261 N92-28648
- VANZANI, V.**
Titan's atmosphere structure from Huygen's-ASI measurements
p 285 N92-32398
- VARDELLE, A.**
Diagnostics of thermal spraying plasma jets
p 213 A92-55403
- VARDELLE, M.**
Diagnostics of thermal spraying plasma jets
p 213 A92-55403
- VASANTA RAM, V.**
On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory
p 184 A92-55479
- VASSALLO, J.**
Electronically steerable antenna for aircraft
p 156 N92-15272
- VASSEL, A.**
The beta-CEZ - A high performance titanium alloy for aerospace engines
p 148 A92-22760
- VASSILICOS, J. C.**
Fractal dimensions and spectra of interfaces with application to turbulence
p 164 A92-20511
- VAUGHAN, G.**
On the relation between total ozone and meteorology
p 236 A92-27796
- VAUTEY, P.**
Innovative constituents requirements to improve composites compressive strength
p 146 N92-33043
- VELDMAN, A. E. P.**
Playing with nonuniform grids
p 172 A92-37936
VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System
[NLR-TR-88081-U] p 192 N92-18323
- VENET, GERARD**
Advanced Study for Active Noise Control in Aircraft (ASANCA)
[AIAA PAPER 92-2092] p 270 N92-32956
- VENIS, A. C. J.**
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] p 187 N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] p 188 N92-14326
- VENN, G.**
The Eurofar program - An European overview on advanced VTOL civil transportation system
p 4 A92-56299
The Eurofar program: An European overview on advanced VTOL civil transportation system
[MBB-UD-0611-91-PUB] p 58 N92-30418
- VENNEMANN, D.**
New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels
[ONERA, TP NO. 1992-39] p 111 A92-48600
- VERCHERE, IAN**
Insurers lose from high-risk deals
p 279 A92-35474
- VERCHEVAL, J.**
Astronautics 1977-1990
[AERONOMICA-ACTA-F-42-1991] p 287 N92-30996
- VERDE, LEOPOLDO**
Robust flight control systems - A parameter space design
p 106 A92-50503
- VERGEINER, I.**
Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670)
p 236 A92-27800
- VERGNOLLE, C.**
Architecture and interconnects of programmable processors of radar signals
p 159 A92-23042
- VERHOEF, A.**
The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer
p 235 A92-17730
- VERMEULEN, J. P.**
Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography
p 208 A92-54321
- VERRON, JACQUES**
The enigmatic merging conditions of two-layer baroclinic vortices
p 162 A92-11225
- VERWARDE, CHRISTIAN**
Aircraft simulations of the POLDER experiment: First results
p 223 N92-11471
- VESCERNYES, Z.**
On the determination of turbulent mixing coefficients from Eulerian current data
p 195 N92-22121
- VEUILLOT, J. P.**
Resolution of Navier-Stokes equations around profiles: Drag evolution
[ONERA-RTS-86/1685-AY-156A] p 186 N92-11310
- VEYNANTE, D.**
The coherent flamelet model for propulsion applications
p 147 N92-27486
- VEYSSEYRE, PH.**
Validation of a 3D Navier-Stokes code on experimental compressor bladings
[ONERA, TP NO. 1991-229] p 13 A92-26381
- VICHEV, B. I.**
Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture
p 222 A92-35007
- VICKOS, JEAN B.**
Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper
p 222 A92-37633
- VIDAL, F.**
Development of an electromyography and accelerometry ambulatory recording system
[CERB-91-07] p 253 N92-19926
- VEILLEFOND, HENRI**
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes
p 252 N92-18994
- VIGNERON, YVON**
EUROFAR airframe aerodynamic design
p 70 A92-35750
- VIL-VIL'AMS, I. F.**
Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine
p 246 A92-39214
- VILHU, O.**
The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma
p 140 N92-10563
- VILLAIN, J.**
France and the Peenemuende legacy
[IAF PAPER 92-0186] p 286 A92-55641
- VILLARD, D.**
Development of an electromyography and accelerometry ambulatory recording system
[CERB-91-07] p 253 N92-19926
- VILLERS, D.**
Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations
p 167 A92-24760
- VILSMEIER, J.**
Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements
[MBB-FE202-S-PUB-0453-A] p 145 N92-17310
Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472] p 87 N92-29650
- VINALL, PETER D.**
Engine reliability
p 95 A92-39309
- VINCENT, C.**
Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre
p 150 A92-36292
- VINCENT, H.**
Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre
p 150 A92-36292
- VINEY, B.**
The turbomachine blading design using S2-S1 approach
p 97 N92-13940
- VISCHER, D.**
Control concepts for active magnetic bearings
p 214 N92-27743
- VISCONTI, G.**
The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model
p 239 A92-53349
- VISINTINI, L.**
Parametric effects of some aircraft components on high-alpha aerodynamic characteristics
p 80 N92-18782
- VISMARA, G.**
EH 101 ship interface trials: Flight test programme and preliminary results
p 82 N92-21964
- VISSER, F. B.**
USO concept in the member states - The Netherlands
p 120 A92-32467
- VISSER, H. G.**
Terminal area traffic management
p 61 A92-50122
- VISSER, J.**
PROCRU simulation results compared with Metro 2 in-flight ILS approach data
[PB92-138502] p 67 N92-70564
- VISURI, TUOMO**
Injuries associated with the use of ejection seats in Finnish pilots
p 247 A92-50292
- VITAGLIANO, P. L.**
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations
[NLR-TP-91046-U] p 51 N92-32730
- VITAGLIANO, P. L.**
The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations
[AIAA PAPER 92-2619] p 256 A92-45492
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations
p 23 A92-47079
Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations
p 259 N92-24411

W

VITALETTI, MARCELLO

- An unfactored implicit scheme for 3D inviscid transonic flows
[AIAA PAPER 92-2668] p 20 A92-45523

VITTING, T.

- On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021

VLOT, ARIE

- Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414

VODENICHAROVA, T.

- Linear panel flutter of an elliptic cylindrical shell p 218 A92-21216

VOELCKERS, U.

- A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027
Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905

VOELCKERS, UWE

- The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041
Design principles of automation aids for ATC approach control p 62 N92-19042

VOGEL, S.

- Computation of flutter boundaries in the time and frequency domain p 46 N92-27952

VOGESEANG, BOUD

- Aerospace Arall - A challenge for the aircraft designer p 143 A92-10232

VOLLAN, ARNE

- A new optical pressure measurement system (OPMS) p 208 A92-54303

VOLLMEYER, HEINRICH

- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003

- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

- The recovering of flow features from large numerical data bases p 189 N92-16231

VOLOVNIK, G. E.

- Exotic states in the cores of quantized vortices for superfluids and superconductors [DE92-728466] p 206 N92-70151

VON DER LIPPE, J. K.

- The Intospace Market Development Strategy and the scenario of provided microgravity, and launch systems p 279 A92-53777

VON RETH, R. D.

- Requirements and possible technical solutions derived from the new airmobility concept of the German Army p 1 A92-14348

- Organization and technical status of the NH90 European helicopter programme p 4 A92-56306

VOS, JAN B.

- A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986

VOSS, R.

- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943

VOTO, C.

- Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053

VREEBURG, J. P. B.

- Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834

VREMAN, A. W.

- A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 N92-29972

VU, B. DANG

- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958

VUCINIC, D.

- CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185

- An integrated CFD system for 3D turbomachinery applications p 101 N92-27464

VUILLERMOZ, P.

- The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143

VUILLOT, A. M.

- Validation of a 3D Navier-Stokes code on experimental compressor bladings [ONERA, TP NO. 1991-229] p 13 A92-26381

WADEY, P. D.

- On the development of Goertler vortices in wall jet flow p 177 A92-44801
Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 N92-24504

WADIER, J. F.

- The beta-CEZ - A high performance titanium alloy for aerospace engines p 148 A92-22760

WADSWORTH, A.

- Aircraft experiments with visible and infrared sensors p 206 A92-37159

WAGNER, ALAIN

- Oriflamme - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles [IAF PAPER 91-207] p 126 A92-14705

- STS 2000 - A reference airbreathing SSTO [AIAA PAPER 91-5013] p 126 A92-17811

WAGNER, B.

- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027

WAGNER, S.

- Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340

- Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95 [AIAA PAPER 92-3956] p 112 A92-56784

WAGSTAFF, ANTHONY S.

- Spinal X-ray screening of high performance fighter pilots p 245 A92-15959

WAHL, TERJE

- SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157

WAHLGREN, B. I.

- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136

WAKE, ALISON J.

- Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

WAKKER, K. F.

- Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949

WALDOCK, J. A.

- Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271

WALKER, N. A.

- High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 N92-20911

WALLACE, S.

- The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

WANG, Z.

- High resolution schemes for steady flow computation p 161 A92-10036

WANHILL, R. J. H.

- Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 N92-28643

- Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 N92-28850

- Short cracks and durability analysis of the Fokker 100 wing/fuselage structure [NLR-TP-90336-U] p 220 N92-29603

- Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307

WANIE, K. M.

- Verification and application of the NSFLEX method for hypersonic flow conditions p 36 N92-15005

WAPENAR, K. E. D.

- Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088

WARD, A. K.

- Low cost spacecraft attitude sensors p 140 N92-24458

WARWICK, GRAHAM

- Clever cockpits p 1 A92-21700

- Tilting at targets p 68 A92-25074

- The other missiles p 2 A92-28184

- Flying on thin ice p 54 A92-38375

- Shear progress p 3 A92-40880

- 777 shaping up p 74 A92-52300

- Silent solutions p 96 A92-53120

WASSELL, A. B.

- The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574

WATERMAN, ELLY H.

- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956

WATKINSON, T. M.

- Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722

WATTS, N.

- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655

WEATHERILL, N. P.

- Mesh adaptivity with the quadtree method p 22 A92-47041

- Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056

- Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090

- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515

WEBB, DAVID C.

- The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510

WEBER, H. W.

- Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615

WEBER, HARRY C.

- The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335

WEBER, M.

- Lightning activity in microburst producing storm cells [ONERA, TP NO. 1991-98] p 235 A92-16080

WEBSTER, M. F.

- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445

WEEDA, D. J. A.

- Quantitative estimation of secondary surveillance radar information p 59 A92-24943

WEGNER, W.

- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943

WEI, W.

- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982

WEILAND, CLAUS

- Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703

WEILL, A.

- Sodar wind speed profiles over forested boundary layer during the Hapex-Mobihy campaign p 235 A92-17729

WEINSTOCK, S.

- Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements [ONERA, TP NO. 1991-157] p 9 A92-16125

WEISER, P.

- Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 N92-14360

WEISS, N. O.

- Asymmetric oscillations in thermosolutal convection p 164 A92-19964

WELL, K. H.

- Optimal guidance anticipating missile performance p 128 N92-27902

WELL, KLAUS H.

- Reentry control of a low-lift maneuverable spacecraft [AIAA PAPER 92-4455] p 124 A92-55216

WELSH, B. L.

- A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345

WELTE, D.

- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693

WENDLING, P.

- A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771

WENDLING, PETER

- Cirrus clouds and condensation trail on 18 Oct. 1989 over the North Sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340

WENDT, J. F.

- Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321

- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 N92-14991

WENZLER, THOMAS

Registration of aircraft in the aircraft registrar using the 'Leasing Decree' of the Federal Minister of Transport of February 12, 1991 p 279 A92-11215

WERNER, CH.

Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 A92-29326
Dense fog on the highway: Visual range monitoring in cars? p 241 A92-31106

WESFREID, J. E.

Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461

WESSELING, K. H.

Control of blood pressure in humans under microgravity p 248 A92-23071

WESSELING, P.

A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 A92-14321

A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 A92-30454

WEST, M. G.

The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199

WESTON, RALPH J.

Noise from military airfields in the United Kingdom p 226 A92-39052

WETTA, P.

Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624

WEYER, THOMAS H.

DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 A92-25413

DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 A92-26086

Activities report of the DLR [ETN-92-91392] p 287 A92-29219

WHITBOURN, L. B.

CO₂ laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 A92-11535

WHITE, A. D.

Initial validation of a R/D simulator with large amplitude motion p 116 A92-28546

WHITE, D. R.

Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318

WHITE, EWART C.

Gosling p 286 A92-30101

WHITELAW, J. H.

Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297

WHITFORD, RAY

Four decades of transonic fighter design p 68 A92-20203

The use of large teams in conceptual aircraft design [AIAA PAPER 92-1092] p 274 A92-33257

WIELING, W.

Control of blood pressure in humans under microgravity p 248 A92-23071

WIENSS, W.

FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 A92-15017

WIERCINSKI, Z.

A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068

WIESEN, B.

Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734

Rarefied gas flow around a disc with different angles of attack p 25 A92-52753

WIGGENRAAD, J. F. M.

Global/local interlaminar stress analysis of a grid-stiffened composite panel [NASA-CR-190822] p 221 A92-33139

WIKSTROM, A.

Esrangle: Sounding rocket and balloon facility p 126 A92-20720

WILDE, P.

On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124

WILDERMUTH, EBERHARD

Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 A92-34152

WILKE, W.

List of reports, 1989 p 278 A92-71169
List of reports, 1990 p 278 A92-71170

WILKINS, J. M.

Asymmetric oscillations in thermosolutal convection p 164 A92-19964

WILLE, S. O.

A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388

An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124

WILLEKE, HERMANN

Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336

WILLETTS, D. V.

The e-beam sustained laser technology for space-based Doppler wind lidar p 240 A92-29300

WILLIAMS, A. L.

Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 A92-29213

WILLIAMS, B. R.

Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 A92-12998

WILLIAMS, D. D.

Hot-gas reingestion - Engine response considerations p 95 A92-45317

WILLIAMSON, MARK

Space law and space technology - A common language p 281 A92-36695

The UK Parliamentary Space Committee - The emergence of a space lobby? p 281 A92-36793

Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773

WILSON, A. E. J.

The near millimetre wavelength optical constants of calcium lanthanum sulphide p 272 A92-52965

WILSON, B.

Sentinel 1000 flight test programme overview and preliminary results [AIAA PAPER 92-1229] p 69 A92-33326

WILSON, F. T.

The achievement of aerodynamic goals on the EH101 project through the 'single site' concept p 75 A92-56342

WILSON, P.

Pilot attitudes to cockpit automation p 250 A92-44926

WIMPENNY, J. C.

Civil aircraft design in relation to airworthiness p 54 A92-39303

WINKLER, P.-J.

Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 A92-32742

WINTER, H.

The role of planning systems in future air traffic management p 64 A92-19050

WINZELL, BENGT

Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 A92-14978

Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 A92-27940

WIRYOHADIATMOJO, E. S. L. H.

Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 A92-28581

WITTENBERG, H.

Introduction of the solid fuel combustion chamber project p 142 A92-22269

WOCH, J.

Signatures of transient boundary layer processes observed with Viking p 230 A92-24532

WOERMANN, D.

Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 A92-27027

WOHLRATH, W.

Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 A92-21693

WOITHE, K.

Fatigue life behaviour of composite structures p 145 A92-18577

WOJTKIEWICZ, ANDRZEJ

Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293

WOLF, KLAUS

Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 A92-14382

WOLKE, W.

DLR research reports and communications [ETN-92-91391] p 287 A92-29218

WONG, H.

Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 A92-15030

Grid impact on 3D hypersonic flows p 39 A92-15041

WOOD, N. B.

Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver p 23 A92-48207

WOOD, PETER

Future developments in aeronautical satellite communications p 158 A92-24167

WOOD, T. D.

Design aspects of the attitude control system for the SOHO spacecraft p 135 A92-24433

WOODFIELD, A. A.

Validation of simulation systems for aircraft acceptance testing p 86 A92-28531

WOODLIFFE, R. D.

The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415

WOODS, ANDREW W.

Melting and dissolving p 178 A92-46260

WOOLISCROFT, LES J. C.

Spacecraft electromagnetic compatibility engineering p 132 A92-33417

WRIGHT, J. R.

Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410

Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133

WRIGHT, K.

Reliability, availability, maintainability, and safety p 216 A92-18639

WRIGHT, K. M.

Safety risk management for ESA space systems p 153 A92-18635

WRIGHT, K. W.

Military and civil software standards and guidelines for guidance and control p 257 A92-12452

WU, J.

A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682

WUETHRICH, S.

Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551

WULZ, H. G.

Two-phase thermal technology for space application: Development status p 138 A92-25834

X

XU, X.

Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125

Y

YAMAMOTO, Y.

Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest [IAF PAPER 91-550] p 246 A92-18547

YANG, Y.

Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 A92-21788

YANG, Z. Y.

Internal flow modelling of vortex throttles p 168 A92-27385

YATES, KEN R.

JPATS escape system development p 70 A92-35434

YAVUZ, K.

Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745

YEE, H. C.

On the numerical treatment of nonlinear source terms in reaction-convection equations [AIAA PAPER 92-0419] p 168 A92-28269

The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814

YELLAND, M. J.

Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 [IOS-288-1991] p 243 A92-29213

YERU, R.

Compressibility effects in turbulent far wakes
p 18 A92-40140

YILLIKCI, Y. K.

Trimming rotor blades with periodically deflecting trailing edge flaps
p 106 A92-56283

YILMAZ, S.

Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture
p 227 A92-39064

YOSHIDA, KAZUYA

Analysis of a redundant free-flying spacecraft/manipulator system
p 132 A92-29704

YOUNG, A. D.

Vortex flow aerodynamics
[AGARD-AR-299]
p 50 N92-30947

YOUNG, COLIN

Lifting line predictions for a swept tip rotor blade
p 7 A92-14424

YUCEIL, BULENT K.

Cylinder-induced shock-wave boundary-layer interaction
p 15 A92-31188

YUCEOGLU, U.

Stresses in rotating, orthotropic, circular, composite disks and plates
p 218 A92-51745

Z

ZACHO, LEON H.

An overview of the planned aerospace test facilities at Capua, Italy
[AIAA PAPER 92-3944]
p 112 A92-56773

ZAHN, J.-P.

Convection-induced shears for general planforms
p 177 A92-44352

ZALEWSKI, P.

A discrete dynamic model of rotating shell-plate-disc structures
p 218 A92-27150

ZAMPARO, P.

Blood lactate during leg exercise in microgravity
p 247 A92-50162

ZANDBERGEN, P. J.

Improved shock-capturing of Jameson's scheme for the Euler equations
[PB92-148758]
p 196 N92-23251

A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence
[MEMO-1009]
p 202 N92-29972

ZAPATA, RICHARD

Physiological protection equipment for combat aircraft: Integration of functions, principal technologies
p 252 N92-18996

ZARIANKIN, ARKADII E.

Total losses in turbulent flows inside conical diffusers
p 23 A92-47782

ZARIFI-RAD, F.

Effect of model cooling on periodic transonic flow
p 22 A92-46900

ZEMACH, C.

A spectral model for turbulent transport
p 178 A92-45095

ZHANG, KEKE

On inertial waves in the earth's fluid core
p 231 A92-37905

ZHANG, XIN

Experimental investigation of supersonic flow over two cavities in tandem
p 15 A92-36830

ZHENG, X.

Effect of viscous damping on the response of floating bodies
p 187 N92-14303

ZHOU, XIN XIN

Propagation of shock waves through clouds
[AERO-REPT-9104]
p 191 N92-18317

ZIADA, S.

Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance
p 176 A92-43045

ZIBORDI, G.

Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon
p 221 A92-17104

ZIENKIEWICZ, O. C.

World Congress on Computational Mechanics, 2nd, Universitaet Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers
p 262 A92-38401

A general explicit or semi-explicit algorithm for compressible and incompressible flows
p 25 A92-52682

ZIESMANN, W.

System safety approach in manned Spacelab missions for control of hazards by software
p 153 N92-18624

ZIMMERMANN, H.

Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines
p 108 N92-23238

Computation of flutter boundaries in the time and frequency domain
p 46 N92-27952

ZIMMERMANN, HELGA

DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics
p 287 N92-25413

DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics
p 287 N92-26086

ZINK, MANFRED

Radiometric calibration of an airborne C-band synthetic aperture radar
p 62 A92-53731

ZIQIANG, Z.

Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations
[PB92-136449]
p 42 N92-21784

ZLOCKA, MARIA

Aircraft stabilization at large angles of attack
p 105 A92-47785

ZOLOTOVSKY, S.

Successful transfer of technology from a research and development laboratory to an Aerospatiale production unit
p 4 A92-51808

ZOTEMANTEL, RAINER

MBB-LAGRANGE: A general structural reliability and optimization structural system
[MBB/FW321/S/PUB/467]
p 220 N92-30423

ZUNINO, PIETRO

Reynolds stress distribution downstream of a turbine cascade
p 17 A92-38861

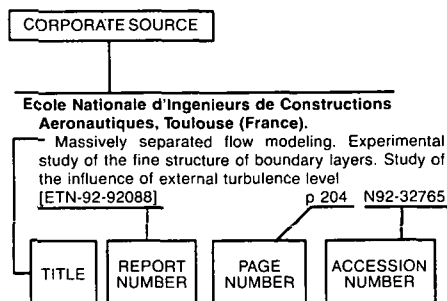
ZUPPARDI, GENNARO

Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique
p 26 A92-54308

ZWAAN, R. J.

Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft
[NLR-TP-90087-U]
p 108 N92-20475

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

A

Academy of Sciences, Graz (Austria).

Balloons for conjugate cusp studies in the 1990's p 233 N92-26315

Academy of Sciences (USSR), Moscow.

Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase [PB92-134170] p 195 N92-22788

Advanced Scientific Computing G.m.b.H., Holzkirchen (Germany).

Numerical prediction of boundary layers and transitional flows p 196 N92-24342

Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

Rotorcraft system identification [AGARD-AR-280] p 75 N92-11001

Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 N92-12517

Vortex Flow Aerodynamics [AGARD-CP-494] p 30 N92-12996

Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 N92-13547

AGARD highlights 91/2 [ISBN-92-835-0634-0] p 286 N92-13916

The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 N92-14046

Calendar of selected aeronautical and space meetings, July 1990 onwards [AGARD-CAL-90/2] p 275 N92-17198

Calendar of selected aeronautical and space meetings, January 1992 and onwards [AGARD-CAL-92/1] p 275 N92-17212

Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659

Manoeuvring Aerodynamics [AGARD-CP-497] p 80 N92-18778

High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972

Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008

Validation of flight critical control systems [AGARD-AR-274] p 108 N92-20026

Air intakes for high speed vehicles [AGARD-AR-270] p 41 N92-20797

Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679

Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951

Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227

Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950

CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450

Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671

Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 N92-27706

Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870

Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887

Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936

Applications of ASICs to avionics [AGARD-AG-329] p 92 N92-28376

Steady and Transient Performance Prediction of Gas Turbine Engines [AGARD-LS-183] p 101 N92-28458

Aircraft ship operations [AGARD-AR-312] p 85 N92-28468

Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-LS-186] p 85 N92-28469

Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315] p 118 N92-30769

Vortex flow aerodynamics [AGARD-AR-299] p 50 N92-30947

Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management [AGARD-AR-310] p 264 N92-32229

Integrated Target Acquisition and Fire Control Systems [AGARD-CP-500] p 92 N92-32437

The Utilization of Advanced Composites in Military Aircraft [AGARD-R-785] p 146 N92-33033

AEG-Electrocom G.m.b.H., Konstanz (Germany).

Extension of the Frankfurt COMPAS for general application p 63 N92-19048

Aeritalia S.p.A., Naples (Italy).

The G-222 aircraft individual tracking programme p 78 N92-18582

Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712

Aeritalia S.p.A., Rome (Italy).

Use of target spectrum for detection enhancement and identification p 157 N92-19155

Aeritalia S.p.A., Turin (Italy).

Vortical flow simulation by using structured and unstructured grids p 30 N92-12999

Software management strategies and practices for space systems development p 258 N92-20610

Aeronautica Macchi S.p.A., Varese (Italy).

Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 N92-18782

Aeronautical Research Inst. of Sweden, Bromma.

Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981

Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 N92-18786

Aeronautical Research Inst. of Sweden, Stockholm.

Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter [FFA-TN-1991-22] p 76 N92-11993

A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991 [FFA-TN-1991-24] p 219 N92-12313

Acoustic characteristics of anechoic chamber at FFA [FFA-TN-1990-43] p 268 N92-12599

Aeroacoustics in inhomogeneous flow field [FFA-TN-1991-30] p 268 N92-12601

MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468

Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168

MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document [FFA-TN-1990-20] p 50 N92-30713

Aeroplane and Armament Experimental Establishment, Boscombe Down (England).

United Kingdom approach to deriving military ship helicopter operating limits p 82 N92-21966

Aerospatiale, Cannes (France).

Critically management in space programs p 275 N92-18619

Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118

Aerospatiale, Les Mureaux (France).

Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 N92-15018

Transitional flows around re-entry bodies p 38 N92-15035

Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 N92-15040

Control of the destruction of a logistic vehicle at reentry p 126 N92-20778

Management of navigation means failure in Hermes space vehicle p 136 N92-24467

Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471

European industrial capabilities to provide meteorological space systems p 228 N92-25238

Aerospatiale, Paris (France).

Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 N92-12065

ACLICO: An aid system for designing bonded joints [REPT-911-430-134] p 152 N92-12146

Aerospatiale, Toulouse (France).

Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579

Flight simulation and digital flight controls p 115 N92-28526

Agusta Sistemi S.p.A., Tradate (Italy).

RAMREC: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 N92-18647

Agusta Sistemi S.p.A., Varese (Italy).

EH 101 ship interface trials: Flight test programme and preliminary results p 82 N92-21964

Air Inter, Lignes Aeriennes Interieures, Paris (France). Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957

Airbus Industrie, Blagnac (France).

Drag reduction: An industrial challenge p 44 N92-27708

Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123

Aircraft Research Association Ltd., Bedford (England). Survey of experimental techniques for performance prediction p 84 N92-23954

Akademiya Nauk Gruzinskoi SSR, Tiflis.

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3 p 269 N92-21773
[PB92-134147]

Alcatel Espace, Toulouse (France).

Future technologies for space: New product assurance concepts p 153 N92-18650

Alenia, Foggia (Italy).

CFRP stiffened panels under compression p 146 N92-33044
Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053

Alenia, Torino (Italy).

Proposal for the new fatigue management system for the AMX p 78 N92-18580
A product assurance engineering concept for complex space systems p 216 N92-18645
Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 N92-18781
Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 N92-19151
AM-X flight simulator from engineering tool to training device p 116 N92-28536

Alenia Aeronautica, Naples (Italy).

Active vibrations and noise control for turboprop application research program activities p 271 N92-32962

Alenia Spazio S.p.A., Naples (Italy).

Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 N92-14980

Alenia Spazio S.p.A., Turin (Italy).

A combined cabin/avionics air loop design for the Space Station logistic module p 253 N92-25841
A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 N92-25881
Moon base habitability aspects p 254 N92-27026

Amsterdam Univ. (Netherlands).

Control of blood pressure in humans under microgravity p 248 N92-23071

Aristotle Univ. of Thessaloniki (Greece).

Three dimensional flow in sharp bends p 200 N92-27481

Association Aeronautique et Astronautique de France, Paris.

Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 N92-11020
Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 N92-11288

Aston Univ., Birmingham (England).

Drag coefficients with applications to satellite orbits p 133 N92-11069

ATConsult, Frankfurt (Germany).

Steps toward acceptance p 63 N92-19046

Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

Simulation and control of large software projects p 258 N92-20615
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836

B**Bath Univ. (England).**

Experimental and analytical studies of jets in quiescent or rotating flow fields p 193 N92-20317

Beleidscommissie Remote Sensing, Delft (Netherlands).

The main lines of the research programs remote sensing: Climate and environment p 230 N92-29499
[BCRS-91-25]
Activities report of the Netherlands Remote Sensing Board (with abridged version) p 225 N92-29688
[ETN-92-91352]
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment p 225 N92-30230
[BCRS-91-28]

Birmingham Univ. (England).

Symposium on dynamic balancing p 221 N92-71104

BMW-A.G., Munich (Germany, F. R.).

Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106

Bristol Univ. (England).

Applications of boundary integral methods to the study of steep free surface waves p 195 N92-23149

British Aerospace Aircraft Group, Kingston-upon-Thames (England).

Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950

British Aerospace Aircraft Group, Warton (England).

Aspects of compression in aerospace composites: Future requirements p 146 N92-33036

British Aerospace Public Ltd. Co., Bristol (England).

Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines p 108 N92-23238
Design aspects of the attitude control system for the SOHO spacecraft p 135 N92-24433
Pre-qualification level testing of an 80 K Stirling cycle cooler p 154 N92-25851

British Aerospace Public Ltd. Co., Lancashire (England).

Some implications for advanced STOVL operation from invincible class ships p 82 N92-21971
Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures p 83 N92-23233
Effective cueing during approach and touchdown: Comparison with flight p 117 N92-28552

British Aerospace Public Ltd. Co., Preston (England).

Development of tactical decision aids p 90 N92-12532

Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data p 81 N92-18790

British Aerospace Public Ltd. Co., Stevenage (England).

Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft p 137 N92-24504
The dynamics of the Cluster spacecraft p 137 N92-24510

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Antarctic studies of the cusp p 233 N92-26301

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The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048

British Petroleum Co. Ltd., London (England).

Spray nozzle for fire control [CA-PATENT-APPL-SN-2-011-94] p 205 N92-32856

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Tornado structural fatigue life assessment of the German Air Force p 79 N92-18592

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The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049

Bureau Veritas, Courbevoie (France).

Organisational robustness for manned space flight p 152 N92-18618

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Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786

C**CAE Electronics Ltd., Saint Laurent (Quebec).**

The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 N92-28539

Cambridge Univ. (England).

Airframe noise p 268 N92-10605
A theoretical investigation of the induced drag of wing of finite aspect ratio [CUED/A-AERO/TR-17(1991)] p 43 N92-22193
Separation of relaminarised boundary layers [CUED/A-AERO/TR-16] p 195 N92-22209
Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464
Boundary layer induced noise in aircraft [CUED/A-AERO/TR-18] p 270 N92-29201

Center for Mathematics and Computer Science, Amsterdam (Netherlands).

Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989

Centre d'Essais Aeronautique Toulouse (France).

Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 N92-14042
Fatigue safety factor: Assessment of associated safety level p 220 N92-18573

Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048

Centre d'Essais en Vol, Istres (France).

Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683

Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 N92-26977

Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France).

Control aspects of the transition from transversal to transonic flow, step effects [ETN-91-90106] p 29 N92-11981

Study of a technique of low level turbulence detection [ETN-91-90107] p 186 N92-12215

Centre d'Etudes et de Recherches, Toulouse (France).

Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 N92-10988

Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code [CERT-RT-63/5618-54] p 185 N92-11306

Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile [CERT-RT-65/5604-35] p 185 N92-11307

Boundary layer transition [CERT-RTS-55/5018-45] p 186 N92-12210

Turbulence control by intake [CERT-RF-67/5004-37] p 186 N92-12211

A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 N92-19294

Double loop control law strategy and applications to helicopter [CERT-2/7724-DERA] p 108 N92-19295

Basic concepts on boundary layers p 44 N92-27707

Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711

Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714

Centre d'Etudes et de Recherches Anthropologie d'Appliquee, Paris (France).

Hypersonic boundary layers: Transition and turbulence effects p 188 N92-14976

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Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926

Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France).

G-LOC. Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984

Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).

Does the future lie in binocular helmet display? p 253 N92-19019

Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).

The pilot flight surgeon bond p 250 N92-13548
Fear of flying p 251 N92-13556

Centre National d'Etudes Spatiales, Paris (France).

Design evolution of the Ariane launching installations p 126 N92-20726

Centre National d'Etudes Spatiales, Toulouse (France).

Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774

Dynamic load cases on Ariane 5 p 127 N92-23797

Gravity field data products from the Aristoteles mission p 224 N92-23925

Centre National d'Etudes Spatiales, Paris (France).

Aerostat for the Mars 1994/1996 mission p 285 N92-24642

The concept of a long duration stratospheric balloon p 43 N92-24645

Spacecraft thermal control coatings p 151 N92-24829

Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300

Centre National de la Recherche Scientifique, Chateaufort (France).

Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 N92-15014

The coherent flamelet model for propulsion applications p 147 N92-27486

Centre National de la Recherche Scientifique, Gif-sur-Yvette (France).

On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499

Centre National de la Recherche Scientifique, Marseille (France).

Numerical simulations around models in hypersonic wind tunnels p 36 N92-14998

Centre National de la Recherche Scientifique, Orsay (France).

The turbomachine blading design using S2-S1 approach p 97 N92-13940

Centre National de Recherches Meteorologiques, Toulouse (France).

TIMS calibration correction by comparison with PRT5 p 223 N92-11412

Centro Italiano Ricerche Aerospaziali, Naples.

High enthalpy nozzle flows p 36 N92-15000
Influence of chemical modelling on hypersonic flow p 37 N92-15015

FLOVIS (FLOW Visualizer) user manual, release 2.6, September 1990 p 190 N92-16238

Chalmers Univ. of Technology, Goeteborg (Sweden).

Finite element methods for flow problems p 200 N92-27672

Civil Aviation Authority, London (England).

UK airmisses involving commercial air transport: September - December 1990 p 56 N92-21746

CJB Developments Ltd., Portsmouth (England).

Air purification systems for submarines and their relevance to spacecraft p 253 N92-25892

Critical technologies: Spacecraft habitability, an update p 254 N92-27010

Commissariat a l'Energie Atomique, Grenoble (France).

The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666

Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875

Compagnia Italiana Servizi Tecnici, Rome.

Standards and S/W development environments; the point of view of a S/W engineering company involved in several space programs p 64 N92-20611

Consejo Superior de Investigaciones Cientificas, La Laguna (Spain).

Planetary vision as a strategy p 229 N92-25243

Construcciones Aeronauticas S.A., Madrid (Spain).

Corrosion tests of meshes in carbon fiber laminates: Impact beam tests p 145 N92-10068

Application of eddy current techniques to graphite composite materials p 145 N92-21416

Controle General des Armees, Paris (France).

Transfers of technology: International negotiations and work in progress p 278 N92-18665

Council for National Academic Awards (England).

Finite element simulation of viscoelastic flow p 205 N92-34038

Cranfield Inst. of Tech., Bedford (England).

Radial inflow turbine study [AD-A240169] p 96 N92-11015

Advanced tactical fighter engine [ETN-92-90840] p 97 N92-18728

Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing [CRANFIELD-AERO-9113-PT-1] p 40 N92-19679

A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips p 81 N92-19701

Some aspects of shock capturing methods for gas dynamics [CRANFIELD-AERO-9112] p 192 N92-19916

A linearised Riemann solver for Godunov-type methods [CRANFIELD-AERO-9116] p 265 N92-19924

An evaluation of in-cabin safety features in passenger aircraft [ETN-92-90656] p 55 N92-20794

A fatigue analysis of the TF89 tactical fighter aircraft [ETN-92-90657] p 81 N92-20795

Radial inflow turbine study [AD-A246936] p 101 N92-28073

Fundamentals of structural optimisation p 86 N92-28470

An investigation into the interface between three closely spaced axis-symmetric bodies at subsonic speed [CRANFIELD-AERO-9114] p 50 N92-31514

ASTOVL combat aircraft design synthesis and optimization [CRANFIELD-AERO-9201] p 88 N92-31515

Radial inflow turbine study [AD-A252783] p 214 N92-33538

Dassault-Breguet Aviation, Saint Cloud (France).

Aircraft tracking optimization of parameters selection p 79 N92-18585

Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970

The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544

Innovative constituents requirements to improve composites compressive strength p 146 N92-33043

Dassault Espace, Saint-Cloud (France).

Structural optimization of aircraft practice and trends p 83 N92-23239

Computational procedures for preliminary design p 84 N92-23952

Defence Research Agency, Bedford (England).

Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546

Defence Research Agency, London (England).

Sector based logic and practice of international companies in the fields of data management and technology transfer p 278 N92-18661

Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).

LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231

Deutsche Airbus G.m.b.H., Bremen (Germany).

Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951

A concept for the revisions of structural inspection schedules p 215 N92-14431

Short time force measurement system p 114 N92-15001

The Operational Loads Monitoring System, OLMS p 79 N92-18586

Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949

Computation of flutter boundaries in the time and frequency domain p 46 N92-27952

Deutsche Airbus G.m.b.H., Hamburg (Germany).

Methodology for assessment of skin repairs on Airbus aircraft p 219 N92-14428

Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547

Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

DME growth elements and their use with MLS p 62 N92-14018

A Taxi And Ramp Management And Control system (TARMAC) p 113 N92-14027

Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany).

Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943

Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany).

Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987

The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041

Design principles of automation aids for ATC approach control p 62 N92-19042

COMPAS system concept p 63 N92-19043

Evaluation of the COMPAS experimental system p 63 N92-19044

Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045

Evaluation of the COMPAS operational system p 63 N92-19047

The role of planning systems in future air traffic management p 64 N92-19050

Flight test of avionic and air-traffic control systems [ETN-92-91063] p 65 N92-25590

The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3 p 84 N92-25591

The basic measuring technical equipment of the DLR test aircraft p 92 N92-25592

Introduction and execution of flight tests at the DLR p 85 N92-25594

ATTAS experimental cockpit and ATMOS for flight control components and systems investigations p 65 N92-25595

Testing of an experimental FMS p 85 N92-25596

Testing concept of a movement area guidance p 65 N92-25597

Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600

Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601

Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603

On board planning of 4D-trajectories p 66 N92-27897

Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905

The role of systems simulation for the development and qualification of ATTAS p 117 N92-28548

Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870

Jet aircraft noise at high subsonic flight Mach numbers [DLR-FB-91-28] p 270 N92-29997

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994

System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624

Preconsiderations on aircraft integration p 224 N92-23402

DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413

DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086

Long-term exposure of bacterial spores to space p 244 N92-27126

Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483

DLR research reports and communications [ETN-92-91391] p 287 N92-29218

Activities report of the DLR [ETN-92-91392] p 287 N92-29219

List of reports, 1989 p 278 N92-71169

List of reports, 1990 p 278 N92-71170

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany).

Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures [DLR-FB-91-09] p 113 N92-12005

On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003

On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949

Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985

Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 N92-14992

Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032

Three-dimensional computer graphics in flow visualization p 189 N92-16227

The recovering of flow features from large numerical data bases p 189 N92-16231

Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany).

Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates [DLR-FB-91-23] p 64 N92-20902

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Munich (Germany).

Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000

Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).

CO2 laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535

Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 N92-19292

Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755

Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329

Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336

D**Dassault (E. M.) Co., Saint Cloud (France).**

A practical experience of Ada for developing embedded software p 257 N92-12465

Structural optimization of aircraft p 86 N92-28472

- Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340
- Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
- Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- The DLR meteorological research aircraft Falcon p 240 N92-26348
- The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349
- Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 N92-29877
- Trial of a slant visual range measuring device p 210 N92-31043
- The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 N92-31813
- Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Weßling (Germany).**
- Optimal guidance anticipating missile performance p 128 N92-27902
- Deutsche Insurance Germany (F.R.).**
- Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 N92-32961
- Deutsche Lufthansa A.G., Frankfurt am Main (Germany).**
- Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 N92-32960
- Deutsche System-Technik G.m.b.H., Bremen (Germany).**
- Testing of an experimental photographic reconnaissance system p 209 N92-25602
- Digital Signal Processing and Control Engineering G.m.b.H., Paderborn (Germany).**
- Code generation for fast DSP-based real-time control p 257 N92-12462
- Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).**
- Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
- Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
- Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- Dornier System G.m.b.H., Friedrichshafen (Germany).**
- Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
- Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
- The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
- Two-phase thermal technology for space application: Development status p 138 N92-25834
- Application of CFD tools in space projects p 197 N92-25897
- Dornier-Werke G.m.b.H., Friedrichshafen (Germany).**
- Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
- Duisburg Univ. (Germany).**
- Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
- Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234
- Durham Univ. (England).**
- Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade p 198 N92-27457
- E**
- Ecole Centrale de Lyon (France).**
- Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle [ETN-92-91959] p 204 N92-32725
- Ecole Centrale de Nantes (France).**
- Interactive visualization of CFD results ASCETE p 190 N92-16235
- Ecole Nationale d'Ingenieurs de Constructions Aeronautiques, Toulouse (France).**
- Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level [ETN-92-92088] p 204 N92-32765
- Ecole Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers (France).**
- Nonstationary flight aerodynamics in a turbulent environment [ETN-91-90102] p 29 N92-11980
- Integrated heat pipe concept for Li/SOCl₂ cells cooling p 160 N92-26974
- Ecole Normale Supérieure, Paris (France).**
- Continuous wavelet analysis of coherent structures p 203 N92-30673
- Ecole Polytechnique, Palaiseau (France).**
- Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037
- Ecole Polytechnique Fédérale de Lausanne (Switzerland).**
- A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
- On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
- Edinburgh Univ. (Scotland).**
- The stratospheric residual circulation as deduced from satellite data p 232 N92-14498
- Eidgenössische Technische Hochschule, Zurich (Switzerland).**
- Mikado: A graphic program p 190 N92-16237
- Control concepts for active magnetic bearings p 214 N92-27743
- Eidgenössisches Flugzeugwerk, Emmen (Switzerland).**
- Separation of external stores: Comparison of results [F+W-TF-2058] p 85 N92-26944
- Electronic System G.m.b.H., Munich (Germany).**
- Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
- Electronique Serge Dassault, Saint Cloud (France).**
- Space software is first of all software p 258 N92-20590
- Emo Raumfahrttechnik G.m.b.H., Bremen (Germany).**
- Collection of product assurance data and their effective utilization p 216 N92-18651
- Protection of spacecraft against meteoroid/orbital debris impacts p 134 N92-23786
- FALKE: Winged re-entry vehicle flight control p 136 N92-24454
- Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- Escuela Técnica Superior de Ingenieros Aeronáuticos, Madrid (Spain).**
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946
- ESDU International Ltd., London (England).**
- Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 N92-11967
- Lift-curve slope of wing-body combinations [ESDU-91007] p 28 N92-11968
- Effect of twin fins on isolated tailplane lift-curve slope [ESDU-91009] p 28 N92-11969
- Maximum lift of wings with trailing-edge flaps at low speeds [ESDU-91014] p 28 N92-11970
- A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows [ESDU-91021] p 39 N92-15970
- Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack [ESDU-91031] p 39 N92-15971
- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution [ESDU-91029] p 39 N92-15973
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers [ESDU-91016-ADD] p 77 N92-15987
- Estimation of airborne performance in landing [ESDU-91032] p 77 N92-15988
- Variability of standard aircraft performance parameters [ESDU-91020] p 77 N92-17847
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 N92-17853
- Prediction of far-field harmonic noise from propellers [ESDU-91033] p 269 N92-18074
- Statistical methods applicable to analysis of aircraft performance data [ESDU-91017] p 77 N92-18096
- Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds [ESDU-91042] p 84 N92-24009
- Aerodynamic centre of wing-body combinations [ESDU-92024] p 50 N92-32479
- A background to the handling qualities of aircraft [ESDU-92006] p 109 N92-32780
- Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds [ESDU-92002-SUPPL] p 51 N92-32782
- European Space Agency, Paris (France).**
- Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 N92-14268
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 N92-14973
- Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961
- Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
- Catalogue of ESA patents [ESA-SP-1131-REV-1] p 287 N92-19411
- Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
- Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 N92-20715
- Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
- Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
- The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967
- Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
- Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
- Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668
- Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4) [ESA-SP-1141] p 122 N92-29879
- Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity [ESA-TT-1235] p 49 N92-30514
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock [ESA-TT-1229] p 148 N92-31942
- Analysis of three icing test flights reaching the aircraft-referred icing degree of severe [ESA-TT-1254] p 58 N92-31943
- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 N92-33996
- Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 N92-34152
- Space: Part of Europe's environment p 122 N92-70627
- European Space Agency. European Space Operations Center, Darmstadt (Germany).**
- Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600
- The integration and test of modern spacecraft control systems p 261 N92-20601
- Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
- Cluster: Fuel optimum spacecraft formation control p 122 N92-24777
- European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).**
- Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- ESA power standard p 141 N92-13174
- Protection concepts used in spacecraft power systems p 142 N92-13176
- Software product assurance requirements for ESA space systems [ESA-PSS-01-21-ISSUE-2] p 257 N92-14631
- Aerothermodynamic challenges for ESA programmes p 34 N92-14974
- Fast finite element solvers for reentry flows p 35 N92-14988
- SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999

Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1
p 189 N92-15030

Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics
p 189 N92-15033

Grid impact on 3D hypersonic flows
p 39 N92-15041

Reliability modeling for non-electronic systems
p 216 N92-18633

Safety risk management for ESA space systems
p 153 N92-18635

Specifying PA/safety design to requirements for the Columbus project and general conclusions
p 153 N92-18649

An evaluation of payload safety requirements for ESA manned spacecraft
p 153 N92-18655

Quality assurance requirements for ESA space systems
p 216 N92-19108

Object oriented hardware simulation of spacecraft control algorithms
p 259 N92-24487

Control strategies for space systems
p 137 N92-24494

ESA standardisation process through the example of manned spacecraft atmospheres
p 253 N92-25842

An overview of ESA cryocooler activities
p 154 N92-25850

Winged launcher thermal design aspects
p 127 N92-27013

Maintainability requirements for ESA space systems
p 217 N92-29878

SCOLE dynamic analysis and frequency response using DISTEL software
p 139 N92-70065

Eurospace, Paris (France).

International collaboration in PA and safety, the Eurospace PA-Panel
p 215 N92-18608

Exeter Univ. (England).

Reliability modeling of the systems whose components have non-constant failure rate
p 216 N92-18648

Instability and transition in compressible boundary layers
p 201 N92-28062

F

Federal Ministry for Defence, Bonn (Germany).

Tool supported software development experiences from the EFA project
p 256 N92-12451

Opportunities for flight simulation to improve operational effectiveness
p 115 N92-28523

Fiat Aviazione S.p.A., Turin (Italy).

Research on inverse methods and optimization in Italy
p 97 N92-13956

Florence Univ. (Italy).

Transonic cascade flow prediction using the Navier-Stokes equations
p 8 A92-15690

Issues for the integration of satellite and terrestrial cellular networks for mobile communications
p 159 N92-30941

Fluid Gravity Engineering Ltd., Witley (England).

Hypersonic aerothermodynamic computations, using a point-implicit TVD method
p 37 N92-15006

Fokker B.V., Schiphol-Oost (Netherlands).

The effect of hoar-frosted wings on the Fokker 50 take-off characteristics
p 56 N92-21692

Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany).

Review of investigations on aeronautical fatigue in the Federal Republic of Germany
p 219 N92-14397

Design and fatigue behaviour of a CFRP/titanium joint for the propan engine CRISP
p 219 N92-14420

Freie Univ., Berlin (Germany).

A note on the interannual variability of the polar vortex in the Arctic
p 233 N92-24659

Futuro S.R.L., Florence (Italy).

Multi-cultural components and keys for European worldwide space programs
p 122 N92-27008

G

GEC Avionics Ltd., Rochester (England).

Formal verification of a redundancy management algorithm
p 257 N92-12457

GEC-Marconi Ltd., Borehamwood (England).

The e-beam sustained laser technology for space-based Doppler wind lidar
p 240 N92-29300

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Aerospace technology: Technical data and information on foreign test facilities
p 113 N92-13076

Genoa Univ. (Italy).

Time-marching methods for secondary flow analysis in curved ducts
p 198 N92-27454

Gesamthochschule, Duisburg (Germany).

Modeling and simulation of complex mechanical systems for space applications
p 135 N92-24389

Gesamthochschule, Essen (Germany).

Interaction between shock wave and tubular flow
p 197 N92-24392

Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin (Germany).

Parallel and vector aspects of a multigrid Navier-Stokes solver
p 260 N92-16645

[PB91-232868]

H

Hamburg Univ. (Germany).

Investigation of convection over sea by aircraft observations
p 225 N92-26337

Helsinki Univ. of Technology, Espoo (Finland).

Vortex nucleation in rotating superfluid He-3-B
p 271 N92-10476

Superfluid vortex nucleation in He-3 flow
p 271 N92-10479

Dynamics of vortices in high-temperature superconductors
p 273 N92-10501

The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma
p 140 N92-10563

Applications of ultra-high vacuum technique to surface and near-surface studies
p 147 N92-14141

[ETN-92-90454]

Vortex motion in rotating superfluid He-3-B
p 194 N92-21763

[PB92-134162]

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3
p 269 N92-21773

[PB92-134147]

Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations
p 42 N92-21784

[PB92-136449]

Modernized MBB panel code: User's guide including background theory
p 43 N92-22233

[PB92-136431]

Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
p 273 N92-22738

[PB92-142421]

Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
p 195 N92-22788

[PB92-134170]

Ultrasonic investigation of (3)He-A vortices in low magnetic fields
p 265 N92-23665

[PB92-142256]

Stabilized finite element methods for the Stokes problem
p 263 N92-24963

[PB92-142298]

TRANSF3: A 3-D grid generator based on transfinite interpolation
p 259 N92-25519

[PB92-151919]

Millimeter wave technology in space
p 283 N92-25782

International Space University: Experiences and observations during Summer 1989
p 275 N92-25786

Space electronic display panel
p 278 N92-25787

Mutual friction in superfluid He-3: Effects of bound states in the vortex core
p 197 N92-26507

[PB92-142231]

The 2D-computation of an axial fan with FINFLO
p 203 N92-30023

[PB92-180678]

Helsinki Univ. of Technology, Otaniemi (Finland).

Exotic states in the cores of quantized vortices for superfluids and superconductors
p 206 N92-70151

[DE92-728466]

Hyperschall-Technologie-Goettingen (Germany).

Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes
p 38 N92-15031

Hyperschall-Technologie-Goettingen, Lindau Harz (Germany).

Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations
p 134 N92-23974

[AD-A243809]

IBIS Aerosystems Ltd., Sharnbrook (England).

Fixed wing night attack EO integration and sensor fusion
p 253 N92-19009

Imperial Coll. of Science and Technology, London (England).

The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18
p 192 N92-18933

[AD-A243810]

Institut d'Aeronomie Spatiale de Belgique, Brussels.

Astronautics 1977-1990
p 192 N92-18934

[AERONOMICA-ACTA-F-42-1991]

Institut de Mecanique de Grenoble (France).

A subgrid-scale model based on the second-order velocity structure function
p 203 N92-30651

Numerical simulation of turbulence at the back of the airplane
p 51 N92-32769

[ETN-92-91664]

Institut de Mecanique des Fluides de Lille (France).

Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow
p 29 N92-11982

[REPT-90/59]

Study of interactions on anemoclinometric sensors
p 113 N92-12006

[REPT-90/30]

Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry
p 187 N92-12216

[REPT-90/55]

Characterization of unsteady aerodynamic phenomena at high angles
p 80 N92-18787

Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).

Existence of non-topological solitons in the self-dual Chern-Simons theory
p 271 N92-21788

[PB92-134402]

Institut National de la Recherche Agronomique, Thiverval-Grignon (France).

Using the radiative surface temperature in energy budget studies over plant canopies
p 223 N92-11506

Institut National de Recherche d'Informatique et d'Automatique, Valbonne (France).

Numerical simulations around models in hypersonic wind tunnels
p 36 N92-14998

Institut National des Sciences Appliquees, Rouen (France).

Marco contract report
p 193 N92-20232

[ETN-92-91077]

Institute of Aviation Medicine, Oslo (Norway).

Aviation psychology in the operational setting
p 250 N92-13550

Domestic problems and aviator family support
p 251 N92-13555

Institute of Oceanographic Sciences, Wormley (England).

Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43
p 243 N92-29213

[IOS-288-1991]

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

Measurement of the flow distribution over the flight deck of an aircraft carrier
p 194 N92-21955

Fuzzy guidance system evaluation
p 259 N92-27903

Instituto Superior Tecnico, Lisbon (Portugal).

Validation of non-orthogonal three-dimensional laminar flow predictions
p 199 N92-27476

International Atomic Energy Agency, Vienna (Austria).

Training guidelines in non-destructive testing techniques
p 217 N92-23258

[DE92-615083]

International Centre for Numerical Methods in Engineering, Barcelona (Spain).

Flow and temperature computations for space vehicles using adaptive finite element techniques
p 35 N92-14990

International Centre for Theoretical Physics, Trieste (Italy).

Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma
p 284 N92-22653

[DE92-614464]

Viscous and Joule heating effects on MHD free convection flow with variable plate temperature
p 273 N92-70166

[DE91-633612]

International Maritime Satellite Organization, London (England).

Implementation of Inmarsat mobile satcom systems
p 157 N92-24073

Aeronautical satellite system test and implementation
p 158 N92-24095

M

- Inmarsat aeronautical mobile satellite system:
Internetworking issues p 158 N92-24098
Future developments in aeronautical satellite
communications p 158 N92-24167
**Istituto Nazionale di Studi Espe Architettura Navale,
Rome (Italy).**
A boundary integral approach in primitive variables for
free surface flows p 187 N92-14304
Italspazio, Rome (Italy).
GPS differential navigation techniques for Carina reentry
and spacecraft rendezvous operations p 135 N92-24443

J

- Jet Propulsion Lab., California Inst. of Tech.,
Pasadena.**
Dual technique magnetometer experiment for the
Cassini Orbiter spacecraft p 139 A92-53412

K

- Kaiserslautern Univ. (Germany).**
Determination of rotordynamic coefficients for labyrinth
seals and application to rotordynamic design
calculations p 213 N92-14360
Karlsruhe Univ. (Germany).
The transpirator, an efficient and light evaporative cooler
for space technology p 154 N92-26986
Kauppa-Ja Teollisuusministerio, Helsinki (Finland).
Tasks of the council and general secretary of the
Commission for Space Industry (Finland) p 276 N92-25785
Kreis Consultancies, Pragg-Jenaz (Switzerland).
On the analysis of liquid filled free-free tanks
p 196 N92-23843

L

- Laboratoire d'Aerothermique du CNRS, Meudon
(France).**
Compression ramp in rarefied gas p 29 N92-11978
Flat planes in rarefied hypersonic flows
[SESSIA-430/91-940] p 29 N92-11979
Flat plates placed in depleted hypersonic flow
[SESSIA-430/91-960] p 50 N92-31508
**Laboratoire de Medecine Aerospatiale,
Bretigny-sur-Orge (France).**
French equipment for integrated protection of combat
aircraft crews: Principles and tests at high altitudes
p 252 N92-18994
Physiological protection equipment for combat aircraft:
Integration of functions, principal technologies
p 252 N92-18996
**Laboratoire de Meteorologie Dynamique du CNRS,
Palaiseau (France).**
Formation and stability of a semi-infinite vorticity line
under an adherence condition p 193 N92-20230
[ETN-92-91075]
Lille-1 Univ., Villeneuve-d'Asoq (France).
Aircraft simulations of the POLDER experiment: First
results p 223 N92-11471
Liverpool Univ. (England).
Boundary layer transition on concave surfaces
p 195 N92-22200
Logica Ltd., London (England).
Why is space software special? p 258 N92-20626
Loughborough Univ. of Technology (England).
The design of spaceborne synthetic aperture radar
[ETN-91-99986] p 156 N92-10114
An examination of the factors affecting the use of
infra-red search and track systems in the air-to-air role
[ETN-91-99987] p 156 N92-11222
A review of UK aviation policy p 5 N92-12988
Aircraft gas turbine emissions: Their nature, technology
for reduction, and a pollution comparison with channel
tunnel transport p 99 N92-22406
[ETN-92-91056]
Yacht sail aerodynamics. Part 1: Optimising overall
performance p 52 N92-70499
[TT-8903-PT-1]
Yacht sail aerodynamics. Part 3: Achievable jibsail
specification p 52 N92-70513
[ISBN-0-904947-17-3]
Yacht sail aerodynamics. Part 2: Achievable mainsail
specification p 52 N92-70514
[ISBN-0-904947-16-5]
Lucas Aerospace Ltd., Birmingham (England).
Software methodologies for safety critical systems
p 257 N92-12467
The development of a range of low vibration mechanical
cryocoolers for space application p 154 N92-25853

Manchester Coll. of Science and Technology (England).

- Turbulence modelling in CFD: Present status, future
prospects p 197 N92-24515
Computational modelling of turbulent flow in S-bends
p 199 N92-27480

Manchester Univ. (England).

- Sydney Goldstein FRS Hon FRAes: An appreciation
[AERO-REPT-8903] p 286 N92-17928
Physical and computational modelling of stratified shear
flows p 190 N92-17974
[AERO-REPT-8909]
A survey of the numerical simulation of unsteady flows
past cavities (with aerodynamic applications)
[AERO-REPT-9002] p 190 N92-18088
Modelling of interfacial and thermocline waves
[AERO-REPT-9006] p 243 N92-18089
Marching with the parabolized Navier-Stokes equations.
Problem 1: Numerical study of hypersonic viscous cone
flow p 40 N92-18231
[AERO-REPT-9007]
Marching with the parabolized Navier-Stokes equations.
Problem 2: Hypersonic viscous flow over a flat plate
[AERO-REPT-9008] p 40 N92-18232
Modelling of interfacial and thermocline waves
[AERO-REPT-9011] p 243 N92-18234
Computation of laminar flow over cavities
[AERO-REPT-9013] p 191 N92-18235
The laminar natural convection on a horizontal surface
[AERO-REPT-9015] p 191 N92-18236
The flow past bluff bodies by a vortex method
[AERO-REPT-9016] p 191 N92-18291
Model parameter identification techniques for flight
flutter testing p 107 N92-18294
[AERO-REPT-9105]
Propagation of shock waves through clouds
[AERO-REPT-9104] p 191 N92-18317
Towards the computation of turbulent hypersonic
flows p 40 N92-18318
[AERO-REPT-9106]
On the approximate representation of velocity and shear
stress distributions in low-speed boundary layers
[AERO-REPT-9012] p 192 N92-18319
Numerical solutions for uniform flow around symmetrical
bodies using panel methods p 192 N92-18320
[AERO-REPT-9014]
Aircraft aerodynamics and stability and control during
air-to-air refueling p 107 N92-18321
[AERO-REPT-9017]
The Goldstein Engineering Research Laboratory
[AERO-REPT-8906] p 5 N92-18322
Modelling of interfacial and thermocline waves
[AERO-REPT-9004] p 243 N92-18340
The installation of the AVRO 9 by 7 foot low-speed wind
tunnel at the University of Manchester (England)
[AERO-REPT-9005] p 114 N92-18341
Vorticity measurements in the near wake of a bluff body
at low Reynolds numbers p 195 N92-22100
[AERO-REPT-9102]
Oxygen isotopes implanted in the LDEF spacecraft
p 272 N92-27284
Aeronautical Engineering Group publications, 1950 -
present p 202 N92-29683
[AERO-REPT-8907]
Massachusetts Univ., Amherst.
Existence of non-topological solitons in the self-dual
Chern-Simons theory p 271 N92-21788
[PB92-134402]
**Mathematischer Beratungs- und
Programmierungsdienst G.m.b.H., Dormund
(Germany).**
Photographic observations of the co-located spacecraft
at 19 deg West p 138 N92-24724
MATRA Espace, Paris-Velzy (France).
The attitude and orbit control system on the Aristoteles
satellite p 135 N92-24445
MATRA Espace, Toulouse (France).
Normalization, reliability and validation of information for
spatial operations p 157 N92-15285
Systems safety: Practical evaluation of sneak circuit
analysis applied to case studies p 160 N92-18630
Influence of microvibrations on spacecraft
performances p 134 N92-23825
Trajectory optimisation and guidance strategies for
reentry p 136 N92-24451
Modern control techniques for spacecraft AOC/GNC
systems p 137 N92-24495
MATRA Marconi Space, Toulouse (France).
Computation of thermal radiation on spacecraft with
mobile parts p 259 N92-25848
SOHO: A challenge in spacecraft thermoelastic design
and verification p 139 N92-25859

- Max-Planck-Inst. fuer Festkoerperforschung, Stuttgart
(Germany).**
Rigid levitation, flux pinning, thermal depinning and
fluctuation in high-Tc superconductors p 273 N92-21635
**Max-Planck-Inst. fuer Physik und Astrophysik,
Garching (Germany).**
The HUS solar flare and cosmic gamma ray burst
detector aboard the Ulysses spacecraft
[MPE-PREPRINT-175] p 283 N92-27049
**Max-Planck-Inst. fuer Radioastronomie, Bonn
(Germany).**
Development of a submillimeter/far infrared heterodyne
spectrometer: Testing on spacecraft as a preparation for
the FIRST project p 209 N92-24363
**Max-Planck-Inst. fuer Stroemungsforschung,
Goettingen (Germany).**
A short or a long cylinder: What difference does it make
to the Karman vortex street? p 40 N92-17314
[MPIS-98/1990]
Investigation on the control of a Karman vortex street
[MPIS-99/1990] p 40 N92-17315
Development of an electronic high speed camera system
for the quantitative analysis of unsteady flows
[MPIS-100/1991] p 209 N92-17344
Stochastic perturbed systems: Theory and practice of
Karman vortex streets p 193 N92-20180
[MPIS-4/1991]
MCG SA, Brussels (Belgium).
Visualization of results of mathematical simulations: The
contribution of MCG p 190 N92-16236
Mentor Graphics (France).
Concurrent engineering p 260 N92-30952
**Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen
(Germany).**
Protection of spacecraft against meteoroid/orbital debris
impacts p 134 N92-23786
FALKE: Winged re-entry vehicle flight control
p 136 N92-24454
Spacecraft attitude control using magnetic torquers and
gas jets p 137 N92-24496
**Messerschmitt-Boelkow-Blohm G.m.b.H., Munich
(Germany).**
A systematic formulation, as an approach to air traffic
[MBB-Z-0371-91-PUB] p 62 N92-10996
Expert system for the Tornado ground-based check-out
system p 91 N92-12536
Avionics systems development: Technological trends,
conflicts, and cost issues in a changing European
environment p 91 N92-14054
Application of MSC/DYNA to shock and impact
problems in aircraft industry p 219 N92-14382
[MBB-UD-0593-91-PUB]
Verification and application of the NSFLEX method for
hypersonic flow conditions p 36 N92-15005
Efficient solution of three-dimensional viscous
hypersonic flows p 37 N92-15007
Viscous shock-layer equations for the calculation of
reentry aerothermodynamics p 37 N92-15008
Aerothermodynamic challenges of the Saenger
space-transportation system p 39 N92-15042
The acoustic flashlight p 282 N92-15938
[MBB-Z-0359-90-PUB]
Comparison of two solution methods for the numerical
calculation of hypersonic flows p 39 N92-17311
[MBB-FE211-S-PUB-446]
Numerical grid generation using a variational method
[MBB-FE211-S-PUB-447] p 190 N92-17312
Aerodynamic development of the X-31 aircraft for the
high angle of attack region p 77 N92-17313
[MBB-FE211-S-PUB-452]
Constraints and difficulties in implementations of RAMS
assurance programmes p 215 N92-17544
[MBB-UK-0141-91-PUB]
Design, analysis, and testing of integrally stiffened
composite centre fuselage skin for future fighter aircraft
[MBB-FE2-PUB-S-450] p 78 N92-18333
The need for active software product assurance
management for systems critical software p 257 N92-18623
Product assurance and safety implementation on Space
Shuttle payloads: An industrial perspective
[MBB-UK-0143-PUB] p 216 N92-18632
A managerial approach for reliability verification of
mechanical equipment p 275 N92-18634
[MBB-UK-0140-PUB]
Integration of RAMS activities during the development
phase of Ariane-5 components (example: VULCAIN thrust
chamber) p 142 N92-18636
[MBB-UK-0144-PUB]
X-31 enhancement of aerodynamics for maneuvering
beyond stall p 80 N92-18779
X-31: Discussion of steady state and rotary derivatives
p 81 N92-18789
Aeroservoelastic stability of aircraft at high incidence
p 108 N92-18795

Modelling of chemical and physical effects with respect to flows around reentry bodies
[MBB-FE-211/S/PUB/0465/A] p 40 N92-19296

High energy propulsion units for the year 2000
[ETN-92-90989] p 129 N92-20249

Three-dimensional simulations of hypersonic flows
[MBB-UK-0155-89-PUB] p 42 N92-21703

Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes
[MBB-FE-211/S/PUB/458/0] p 194 N92-21704

Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows
[MBB-FE211-S-PUB-449] p 42 N92-22179

Problem 3: Flow over a 2-D ramp Navier-Stokes calculations
p 42 N92-22180

Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation
p 42 N92-22181

Case 7.4 delta wing: Navier-Stokes calculation
p 42 N92-22182

Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation
p 42 N92-22183

First approach to an integrated fin design
p 83 N92-23236

Recommended system concept
p 224 N92-23383

Passive optical and IR sensors
[MBB-UH-HE512] p 224 N92-23392

Quick-look system
p 224 N92-23393

Sensor compatibility/optimal sensor combinations
p 224 N92-23403

National user interfaces
p 224 N92-23407

Market directed thinking in a technological operation
p 276 N92-23929

Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft
p 84 N92-23951

CFD contributions during hypersonic airplane intake design
p 199 N92-27472

Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations
p 45 N92-27945

Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example
p 86 N92-28471

Mathematical optimization: A powerful tool for aircraft design
p 86 N92-28474

Diode-pumped Nd:YAG lidar for airborne cloud measurements
p 210 N92-29326

Saenger: The reference concept and its technological requirements - aerothermodynamics
[MBB-FE-202-S-PUB-0463-A] p 128 N92-29629

Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics
[MBB-FE-202-S-PUB-0464-A] p 48 N92-29648

Aerothermodynamics and propulsion integration in the Saenger technology programme
[MBB-FE-202-S-PUB-0469-A] p 48 N92-29649

Concurrent engineering in design of aircraft structures
[MBB-FE-2-S-PUB-472] p 87 N92-29650

Aerothermodynamic challenges of the Saenger space-transportation system
[MBB-FE-202-S-PUB-0462-A] p 129 N92-29680

Hypersonic flow past radiation-cooled surfaces
[MBB-FE-202-S-PUB-0468-A] p 49 N92-29713

Repair procedures for advanced composites for helicopters
[MBB-UD-0606-91-PUB] p 5 N92-29874

Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle
[MBB-FE202/S/PUB/461] p 5 N92-30232

The Eurofar program: An European overview on advanced VTOL civil transportation system
[MBB-UD-0611-91-PUB] p 58 N92-30418

MBB-LAGRANGE: A general structural reliability and optimization structural system
[MBB-FW321/S/PUB/467] p 220 N92-30423

Multidisciplinary optimization of fiber composite aircraft structures
[MBB-FW321/S/PUB/476] p 87 N92-30424

Calculation of viscous hypersonic flows in chemical non-equilibrium
[MBB-FE211/S/PUB/466] p 204 N92-30674

Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics
[MBB-FE211/S/PUB/474] p 5 N92-30675

CFD contributions during hypersonic airplane intake design
[MBB-FE213/S/PUB/459] p 50 N92-30676

New accelerated corrosion test methods
[MBB-Z-0406-91-PUB] p 150 N92-32895

MBB Deutsche Aerospace financial year
[ETN-92-91908] p 276 N92-33686

Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany).
Lite-Sat's for specific communication tasks
p 156 N92-15232

Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements
[MBB-FE202-S-PUB-0453-A] p 145 N92-17310

Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool
p 116 N92-28541

Examples of advanced near-net shape manufacturing techniques for aerospace
[MBB-Z-0399-91-PUB] p 154 N92-32742

Metraflu, Ecully (France).
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications
[ETN-92-90867] p 192 N92-19349

Pressure field developed by the random movement of the vortices near a wall
[ETN-92-91665] p 204 N92-32770

Micro Circuit Engineering Ltd., Tewkesbury (England).
Applications of silicon hybrid multi-chip modules to avionics
p 92 N92-28379

Minister fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein, Westfalen (Germany).
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990
[ETN-92-91068] p 287 N92-24351

Ministry of Defence, London (England).
Avionics software evolution
p 91 N92-14052

Aircraft fatigue management in the Royal Air Force
p 79 N92-18591

Ministry of Defence, Paris (France).
Avionics standardization in Europe
p 91 N92-14050

Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany).
Computation and visualization of specific flow phenomena in turbomachinery application
p 100 N92-27463

The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle
p 200 N92-27482

N

Napier Coll., Edinburgh (Scotland).
Dynamic solder management
[AD-A250564] p 150 N92-29647

Naples Univ. (Italy).
Infrared measurements of aerodynamic heating in hypersonic wind tunnel
p 114 N92-15002

Aspects of non-equilibrium in arc-heated wind-tunnel simulation
p 114 N92-15012

Linear acoustics in gas mixtures with rate processes
p 269 N92-15013

National Aeronautics and Space Administration, Washington, DC.
A 3D finite element multigrid solver for the Euler equations
[AIAA PAPER 92-0449] p 171 A92-31665

The computation of three-dimensional flows using unstructured grids
p 16 A92-37539

A general explicit or semi-explicit algorithm for compressible and incompressible flows
p 25 A92-52682

National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.
On the numerical treatment of nonlinear source terms in reaction-convection equations
[AIAA PAPER 92-0419] p 168 A92-26269

A 3D finite element multigrid solver for the Euler equations
[AIAA PAPER 92-0449] p 171 A92-31665

Gravity effects on reproduction, development, and aging
p 244 A92-34193

Turbulence - The filtering approach
p 175 A92-41656

The numerical dynamic for highly nonlinear partial differential equations
p 175 A92-41814

Experimental and computational studies of hovering rotor flows
p 22 A92-46954

A general explicit or semi-explicit algorithm for compressible and incompressible flows
p 25 A92-52682

The computation and validation of hovering rotor performance
p 74 A92-56285

National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.
Terrestrial ionospheric signatures of field-aligned currents
p 231 A92-31275

Optical effects of polar stratospheric clouds on the retrieval of TOMS total ozone
p 231 A92-54645

National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.
Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers
p 26 A92-53080

BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW
p 268 A92-56344

Homogeneous and heterogeneous chemistry along air parcel trajectories
p 232 N92-14541

Lidar measurements of aerosol and ozone distributions during the 1992 Airborne Arctic Stratospheric Expedition
p 229 N92-29304

National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH.
Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids
p 14 A92-28523

National Aerospace Lab., Amsterdam (Netherlands).
A knowledge-based assistant for diagnosis in aircraft maintenance
p 5 N92-12538

Reasoning with uncertain and incomplete information in aerospace applications
p 261 N92-12544

Modeling and numerical simulation of vortex flow in aerodynamics
[AD-B163670L] p 30 N92-12997

Analysis of results of an Euler-equation method applied to leading-edge vortex flow
p 30 N92-13000

An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
p 31 N92-13011

Review of aerodynamic design in the Netherlands
p 76 N92-13929

Monitoring load experience of individual aircraft
[NLR-TP-90084-U] p 77 N92-15065

Development environment for digital manipulator simulators
[PB91-222190] p 213 N92-16313

CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations
[NLR-TR-88154-U] p 191 N92-18221

VISIAN: A Viscous-Inviscid Strong-Interaction Analysis System
[NLR-TR-88081-U] p 192 N92-18323

Model incidence measurement using SAAB ELOPTOPOS system
[NLR-TP-89182-U] p 115 N92-18416

Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device
p 78 N92-18583

Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDIF
[NLR-TR-88108-U] p 64 N92-19491

Inviscid drag prediction for transonic transport wings using a full-potential method
[NLR-TP-89365-U] p 41 N92-20473

Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft
[NLR-TP-90087-U] p 108 N92-20475

Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds
[NLR-TP-90029-U] p 41 N92-20498

Panel methods for aerodynamic analysis and design
p 84 N92-23955

Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations
p 259 N92-24411

NLR inviscid transonic unsteady loads prediction methods in aeroelasticity
p 45 N92-27947

Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft
p 108 N92-27958

Aircraft simulation and pilot proficiency: From surrogate flying towards effective training
p 115 N92-28532

Improvement of separations of practice bombs from a multiple bomb adapter
[NLR-TP-90307-U] p 86 N92-28634

Hyperbolic grid generation with BEM source terms
[NLR-TP-90334-U] p 264 N92-28635

Spacecraft sustained load fracture control
[NLR-TP-89163-U] p 220 N92-28643

Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators
[NLR-TP-90028-U] p 261 N92-28648

The use of load enhancement factors in the certification of composite aircraft structures
[NLR-TP-90068-U] p 86 N92-28649

Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11
[NLR-TP-90070-U] p 220 N92-28650

Modifications and results of flight tests of a practice bomb adapter
[NLR-TP-90108-U] p 87 N92-28651

Some longitudinal handling qualities design guidelines for active control technology transport aircraft
[NLR-TP-90129-U] p 109 N92-28652

- Response of helicopters to gusts
[NLR-TP-90159-U] p 109 N92-28653
- Potential applications of laser Doppler anemometry for in-flight measurements
[NLR-TP-90163-U] p 92 N92-28654
- Application of knowledge-based systems for diagnosis of aircraft systems
[NLR-TP-90192-U] p 57 N92-28655
- Results of an Euler-equation method applied to leading-edge vortex flow
[NLR-TP-90368-U] p 47 N92-28657
- Comparison of LDA and LTA applications for propeller tests in wind tunnels
[NLR-MP-88031-U] p 47 N92-28658
- Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods
[NLR-TP-89119-U] p 47 N92-28659
- Constrained spanload optimization for minimum drag of multi-lifting-surface configurations
[NLR-TP-89126-U] p 47 N92-28660
- The windtunnel as a tool for laminar flow research
[NLR-TP-90145-U] p 117 N92-28661
- LAH-main rotor model test at the DNW
[NLR-TP-90305-U] p 87 N92-28687
- Atmospheric turbulence spectra and correlation functions
[NLR-TP-89217-U] p 234 N92-28689
- Development and validation of a characteristic boundary condition for a cell-centered Euler method
[NLR-TP-90144-U] p 47 N92-28692
- Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects
[NLR-TP-90184-U] p 201 N92-28694
- Wave drag determination in the transonic full-potential flow code MATRICS
[NLR-TP-90062-U] p 47 N92-28709
- Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement
[NLR-TP-90134-U] p 202 N92-28712
- Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys
[NLR-TP-90172-U] p 220 N92-28850
- NARSIM: A real-time simulator for air traffic control research
[NLR-TP-90147-U] p 117 N92-29204
- Short cracks and durability analysis of the Fokker 100 wing/fuselage structure
[NLR-TP-90336-U] p 220 N92-29603
- Hyperbolic grid generation control by panel methods
[NLR-TP-91061-U] p 264 N92-29604
- European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions
[NLR-TP-91062-U-PT-1] p 66 N92-29605
- Application of VME-technology on an airborne data link processor unit
[NLR-MP-88040-U] p 66 N92-29615
- Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft
[NLR-MP-88044-U] p 87 N92-29616
- On the optimization of windshear warning and guidance systems
[NLR-TP-90196-U] p 57 N92-29703
- CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration
[NLR-TP-89103-U] p 225 N92-29707
- Evaluation of measured-boundary-condition methods for 3D subsonic wall interference
[NLR-TR-88072-U] p 49 N92-29884
- Examination of aircraft warning and caution lights after shock testing
[NLR-TP-89284-U] p 58 N92-30474
- Modeling and numerical simulation of vortex flow in aerodynamics
[NLR-TP-91154-U] p 51 N92-32673
- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations
[NLR-TP-91046-U] p 51 N92-32730
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds
[NLR-TP-91117-U] p 51 N92-32732
- Integration of wall interference assessment and wall adaptation
[NLR-TP-91119-U] p 118 N92-32734
- NLR investigations of flutter behaviour of fighter aircraft with external stores
[NLR-TP-91134-U] p 109 N92-32750
- Development of new flight procedures for the Microwave Landing System (MLS)
[NLR-TP-91156-U] p 66 N92-32830
- Investigations preparatory to the Wet Satellite Model Experiment
[NLR-TP-91219-U] p 139 N92-32834
- CFD efforts in the Netherlands
[NLR-TP-91250-U] p 205 N92-32835
- Global/local interlaminar stress analysis of a grid-stiffened composite panel
[NASA-CR-190822] p 221 N92-33139
- Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694
- SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods
[PB91-219444] p 52 N92-70249
- Damage tolerance and durability evaluation of aluminum-lithium alloys
[PB91-219477] p 150 N92-70307
- The 3-D Euler flows around modern airplanes
[PB92-138759] p 52 N92-70540
- Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils
[PB92-138569] p 206 N92-70561
- Selection of a laser anemometer technique for propeller tests in wind tunnels
[PB92-138510] p 118 N92-70563
- PROCRU simulation results compared with Metro 2 in-flight ILS approach data
[PB92-138502] p 67 N92-70564
- Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions
[PB92-138577] p 118 N92-70574
- Definition of P.S.D.-design loads for nonlinear aircraft
[PB92-138619] p 88 N92-70575
- System for transonic wing design with geometric constraints based on an inverse method
[PB92-138692] p 53 N92-70576
- Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow
[PB92-138718] p 53 N92-70577
- Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program
[PB92-138676] p 53 N92-70590
- Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989
[PB92-138650] p 88 N92-70591
- LARVE: A hypersonic flight test facility launched by Ariane 4
[PB92-138726] p 118 N92-70983
- National Aerospace Lab., Emmeloord (Netherlands).**
Ageing aircraft research in the Netherlands
p 57 N92-30129
- National Aerospace Medical Centre, Soesterberg (Netherlands).**
Radiation exposure of civil air carrier crewmembers
[NLRGC/B-1-4/91] p 249 N92-33908
- National Technical Univ., Athens (Greece).**
Unsteady Euler calculations in 3D internal aerodynamics
p 199 N92-27470
- National Transportation Safety Board, Washington, DC.**
Aircraft accident report: Unstabilized approach and loss of control NPA, Inc. dba United Express Flight 2415, British Aerospace BA-3101, N410UE, Tri-Cities Airport, Pasco, Washington, December 26, 1989
[PB91-910406] p 56 N92-21873
- Naval Postgraduate School, Monterey, CA.**
Aircraft observations of the atmospheric boundary layer in the vicinity of the marginal ice zone under conditions of flow parallel to the ice edge
[AD-A241072] p 232 N92-13512
- An investigation of cold overflow over the Iceland/Faeroes Ridge
[AD-A243084] p 242 N92-17169
- A numerical study of time-dependent wind forcing off the west coast of Portugal, 1987-1988
[AD-A246775] p 243 N92-28365
- Nelson Space Services Ltd., London (England).**
Concept for a European Space Station: Habitability, life support, and laboratory facilities
p 254 N92-27023
- Netherlands Aerospace Medical Centre, Soesterberg.**
G-tolerance and spatial disorientation: Can simulation help us?
p 248 N92-28534
- New Mexico Univ., Albuquerque.**
Existence of non-topological solitons in the self-dual Chern-Simons theory
[PB92-134402] p 271 N92-21788
- Newcastle-upon-Tyne Univ. (England).**
Effect of viscous damping on the response of floating bodies
p 187 N92-14303
- Nice Univ. (France).**
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft
p 285 N92-25679
- Normalair-Garrett Ltd., Yeovil (England).**
Advances in the design of military aircraft breathing systems with respect to high altitude and high acceleration conditions
p 252 N92-18999
- Norwegian Defence Research Establishment, Kjeller.**
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models
[FFI-91/7007-VOL-3] p 156 N92-12157
- Ocean/bottom acoustic interaction with arbitrary bottom profile
[FFI-91/7009] p 242 N92-12386
- Norwegian Space Center, Oslo.**
Space technology and industries in Norway
[NSC-REPT(91)-8] p 153 N92-19521
- The Norwegian sounding rocket and balloon programme
p 122 N92-24594
- Nottingham Univ. (England).**
Remote sensing of seasonal variations in albedo over southern Britain
p 241 N92-33969
- Nuevas Tecnologias Espaciales S.A., Lisse d'Amunt (Spain).**
Study on the requirements for the installation of a CES and habitability centre
p 254 N92-27007
- Oak Ridge National Lab., TN.**
Heat pump systems with direct expansion ground coils
[DE92-007831] p 195 N92-23120
- Office National d'Etudes et de Recherches Aeronautiques, Paris (France).**
Vortex flow on a missile body: Experimental study and modeling
p 32 N92-13013
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations
p 32 N92-13018
- Office National d'Etudes et de Recherches Aeronautiques, Meudon (France).**
Theoretical simulation of a 2 micron airborne solid state laser anemometer
p 210 N92-31059
- Office National d'Etudes et de Recherches Aeronautiques, Paris (France).**
Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid
p 185 N92-10163
- Numerical simulation of vortex breakdown via 3-D Euler equations
p 185 N92-10164
- Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh
[ONERA-RT-56/3064-RY-006-R] p 28 N92-10989
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary
[ONERA-RTS-21/4365-AY-056A] p 76 N92-11009
- Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile
[ONERA-RSF-44/1147-AY-144A] p 185 N92-11308
- Resolution of Navier-Stokes equations around profiles: Drag evolution
[ONERA-RTS-86/1685-AY-156A] p 186 N92-11310
- Eighty years of aerospace technique through ATMA bulletins
[ETN-91-90097] p 286 N92-11963
- Thermographic gust wind tunnel measurements
[ONERA-RF-31/3409-PY] p 29 N92-11972
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles
p 133 N92-14977
- Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography
p 114 N92-15003
- Ablation and temperature sensors for flight measurements in reentry body heat shields
p 209 N92-15004
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection
p 38 N92-15025
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies
p 188 N92-15029
- Circulatory biomechanics effects of accelerations
p 248 N92-18991
- Drag prediction using computation methods
[ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682
- Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow
[ONERA-NT-1991-9] p 193 N92-19932
- Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests
[ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
- Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France)
[ONERA-RT-16/3641-PY] p 269 N92-20387
- Atmospheric transmission of polar meteorites
[ONERA-NT-1991-5] p 284 N92-20477
- Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction
[ONERA-RS-97/5094-PY] p 269 N92-21736

P

- Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
- Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
- Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469
- Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
- Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
- Direct coupling of fluid structure in transonic aerelasticity p 46 N92-27954
- Use of a research simulator for the development of new concepts of flight control p 116 N92-28543
- Construction of a numerical optimization method for the definition of hypersonic profiles [ONERA-RSF-43/1736-AY-146A] p 202 N92-28788
- Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728-] p 48 N92-28789
- Study of the loss of consciousness inflight by fighter aircraft pilots [ONERA-RSF-11/3446-EY] p 249 N92-28844
- Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration [ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- Survey of French activities concerning structural airworthiness and aging aircraft p 57 N92-30130
- Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations [ONERA-RSF-24/1408-AY-150A] p 51 N92-32773
- Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes [ONERA-RT-44/1621-RY-016-R] p 204 N92-32776
- Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements [ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- Flutter models: Their design, manufacture, and ground testing p 109 N92-34164
- Unsteady wind tunnel tests p 109 N92-34166
- Office National d'Etudes et de Recherches Aérospatiales, Toulouse (France).**
- Formal specification of satellite telemetry: A practical experience p 129 N92-12456
- Characteristics of a boundary layer in a leading edge vortex p 31 N92-13012
- Office of Technology Assessment, Washington, DC.**
- Biotechnology in a global economy. Volume 2, part 1: Contractor documents [PB91-212068] p 228 N92-13494
- Officine Galileo S.p.A., Florence (Italy).**
- Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 N92-24474
- OHB-System G.m.b.H., Bremen (Germany).**
- FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
- Balloon-borne drop capsule MIKROBA p 152 N92-24617
- Oldenburg Univ. (Germany).**
- Introduction: Ocean air observation p 224 N92-23381
- Seaborne lidar system p 224 N92-23389
- Oslo Univ. (Norway).**
- The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295
- Oulu Univ. (Finland).**
- CAPS-plasma spectrometer for the Cassini spacecraft p 140 N92-10565
- Second Meeting of Finnish Space Researchers [REPT-117(1990)] p 282 N92-25758
- Oxford Univ. (England).**
- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 N92-12203
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 N92-12206
- Robust control system design with high performance helicopters p 108 N92-19621
- Tracer transport in the middle atmosphere p 229 N92-26473
- Cell vertex methods for compressible gas flows p 197 N92-26599
- Turbulent spot generation and growth rates in a transonic boundary layer [AD-A250221] p 202 N92-29118

- Padua Univ. (Italy).**
- Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- Paris VI Univ. (France).**
- On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
- Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- Physics and Electronics Lab. TNO, The Hague (Netherlands).**
- Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378
- Polish Academy of Sciences, Warsaw.**
- The CSMA/CD local area network for hospital services p 157 N92-15284
- Politecnico di Milano (Italy).**
- Numerical simulation of vortex flows past impulsively started wings p 33 N92-13028
- Politecnico di Torino (Italy).**
- Nonequilibrium 3D flows of air through inlets p 200 N92-27487
- A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
- Portuguese Air Force, Alfragide.**
- Fatigue management for the A-7P p 79 N92-18593
- Prins Maurits Lab. TNO, Rijswijk (Netherlands).**
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- Spin-offs of the solid fuel combustion chamber project p 143 N92-22275

R

- Reading Univ. (England).**
- Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056) p 272 N92-27108
- Renaudie (J. F.), Versailles (France).**
- Flight in adverse environmental conditions p 55 N92-21680
- Rijkswaterstaat, Delft (Netherlands).**
- Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
- Rolls-Royce Ltd., Bristol (England).**
- Recent developments at the Shrotonbury (England) STOVL Test Facility [PNR-90806] p 115 N92-22096
- VSTOL engine design evolution: Growth of the Pegasus engine for Harrier [PNR-90805] p 99 N92-27039
- ASTOVL engine control [PNR-90808] p 100 N92-27040
- Thermally sprayed coating systems for surface protection and clearance control applications in aero engines [PNR-90802] p 100 N92-27422
- Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484
- Rolls-Royce Ltd., Derby (England).**
- Introduction: Needs and approaches to reliability and quality assurance in design and manufacture p 216 N92-19005
- Materials and process directions for advanced aero-engine design [PNR-90814] p 98 N92-19938
- Re-engineing appears to offer best payback for young: Chapter 2 compliant aircraft [PNR-90848] p 98 N92-19939
- Use of CFD in the design of a modern multistage aero engine LP turbine design [PNR-90862] p 98 N92-20179
- The requirements and management of quality audits and reviews [PNR-90840] p 275 N92-20458
- ETOPS: A developing scene [PNR-90844] p 98 N92-20459
- The impact of aircraft noise control technology [PNR-90846] p 269 N92-20461
- The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology [PNR-90847] p 228 N92-20574
- The role of crack growth in defect assessment [PNR-90798] p 220 N92-20909

- High temperature processing and deformation of a near-alpha titanium alloy [PNR-90853] p 149 N92-20911
- Keys to excellence in design and manufacture [PNR-90781] p 276 N92-20927
- The environmental challenges for the next supersonic aircraft [PNR-90782] p 228 N92-20928
- Emissions from aircraft: Standards and potential for improvement [PNR-90768] p 98 N92-21740
- Practical application of 3-D CFD methods to gas turbine combustors [PNR-90773] p 194 N92-21742
- Environmentally sound [PNR-90776] p 228 N92-21743
- The search for new materials [PNR-90777] p 145 N92-21744
- The proposed revision to RTCA DO178A and its influence on system design [PNR-90821] p 258 N92-21847
- Compressing the compressor [PNR-90824] p 99 N92-21848
- The evolution of the bypass engine [PNR-90832] p 99 N92-21850
- EC funding of collaborative research projects [PNR-90833] p 279 N92-21851
- Impact of regulation changes on engine design and certification [PNR-90789] p 99 N92-22098
- The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation [PNR-90791] p 194 N92-22099
- ASTOVL propulsion systems: Configuration and concept choice [PNR-90809] p 100 N92-27041
- The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471
- Re-engineing for real stage 3 compliance [PNR-90872] p 102 N92-33748
- The Rolls-Royce Trent [PNR-90875] p 88 N92-33750
- The impact of air transport on the environment [PNR-90876] p 230 N92-33751
- Rolls-Royce Ltd., Leavesden (England).**
- Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems [PNR-90839] p 98 N92-20573
- Rome Univ. (Italy).**
- Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 N92-14997
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- Royal Aerospace Establishment, Bedford (England).**
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 N92-12004
- Approach and landing guidance p 65 N92-21960
- A review of scale effects on surfaces in unsteady motion p 46 N92-27962
- Validation of simulation systems for aircraft acceptance testing p 86 N92-28531
- Royal Aerospace Establishment, Farnborough (England).**
- Integrating machine intelligence into the cockpit to aid the pilot p 252 N92-12533
- Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 N92-14007
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 N92-14319
- Dynamic wind tunnel tests on control of forebody vortices with suction p 107 N92-18793
- Pulmonary effects of high-G and positive pressure breathing p 248 N92-18978
- High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations p 252 N92-19000
- The RAF Institute of Aviation Medicine proposed helmet fitting/retention system p 253 N92-19013
- A review of icing research at the Royal Aerospace Establishment p 56 N92-21689
- Debris reentry prediction: Salyut-7/Kosmos-1686 p 125 N92-23973
- Limitation of space debris in geostationary transfer orbit p 125 N92-24774
- Application of S1BYL2 to the AGARD WG18 compressor test cases p 198 N92-27452
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row p 101 N92-27466
- Practical considerations in designing the engine cycle p 102 N92-28460

Royal Air Force, London (England).

Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991
p 264 N92-27888

Royal Air Force Coll., Cranwell (England).

Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport
[ETN-92-91056] p 99 N92-22406

Royal Aircraft Establishment, Farnborough (England).

Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing
[AD-B163639L] p 30 N92-12998
Review of aircraft dynamic loads due to flow separation p 31 N92-13008
Asymmetric vortex flow over circular cones p 32 N92-13014

An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 N92-13015

Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 N92-13022

An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 N92-13023

Surface activation of Concorde by Be-7 p 271 N92-23295

The changing role of experimentation in aeroengine R and D: The point of view of the research worker
[AD-A246372] p 100 N92-27062

Ruhr Univ., Bochum (Germany).

Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames
[ETN-92-92103] p 205 N92-33916

Rutherford Appleton Lab., Chilton (England).

Reduction of target scattering by tropospheric modification p 157 N92-19164

Rutherford High Energy Lab., Chilton (England).

Requirements for coordinated Cluster and ground-based observations of the cusp p 233 N92-26318

S

Saab Aircraft Co., Linköping (Sweden).

Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940

Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952

Saab-Scania, Linköping (Sweden).

The structural optimization system OPTSYS: Current status and applications p 83 N92-23232

A manufacturer's approach to ensure long term structural integrity p 57 N92-30133

Saab Space A.B., Goeteborg (Sweden).

Implementation of the total quality management concept within space business p 275 N92-18640

Saab-Space A.B., Linköping (Sweden).

Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978

Satellite Operational Services G.m.b.H., Gilching (Germany).

Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721

Satellites International Ltd., Newbury (England).

Low cost spacecraft attitude sensors p 140 N92-24458

Skoe (Ivar Helge), Kongsberg (Norway).

A PC-based inverse design method for radial and mixed flow turbomachinery p 97 N92-13943

Smiths Industries Aerospace and Defence Systems Ltd., Cheltenham (England).

Military and civil software standards and guidelines for guidance and control p 257 N92-12452

Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

A heat switch for space cryocooler applications p 160 N92-25852

Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).

Approach and landing assisted by onboard image processing p 64 N92-21959

Societe d'Etudes et de Services pour Souffleries et Installations Aerothermodynamiques, Paris (France).

Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 N92-14995

Societe des Accumulateurs Fixes et de Traction, Romainville (France).

Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 N92-27148

Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France).

Large thin composite thermostructural parts p 134 N92-23821

Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Cincinnati, OH.

Recent progress in inverse methods in France p 97 N92-13938

Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Molssy-Cramayel (France).

Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461

Southampton Univ. (England).

Jet noise classical theory and experiments p 268 N92-10602

Interference heating near fin/body junctions on hypersonic vehicles p 36 N92-14996

The dynamic response of separated hypersonic flows p 38 N92-15019

Risk to hearing from overflight noise of military aircraft [ISVR-TR-194] p 270 N92-22241

Magnetic suspension using high temperature superconducting cores p 161 N92-27789

Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 N92-27804

State Secretary of Science Policy, Brussels (Belgium).

The role of Belgium in Earth observation from space programs p 229 N92-25245

Stato Maggiore Marina, Rome (Italy).

Limitations on helicopter operations in the aeronaval environment p 82 N92-21973

Stuttgart Univ. (Germany).

The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009

Suomen Ilmailumuseo, Vantaa (Finland).

Air museum p 283 N92-25761

Society of space studies p 283 N92-25762

Swedish Inst. of Space Physics, Kiruna.

The need of coordinated observations in space and from ground p 233 N92-26310

Swedish Space Corp., Esrange.

Esrange: Sounding rocket and balloon facility p 126 N92-20720

T

Tampere Univ. of Technology (Finland).

Low pressure impactor with electrical concentration detection p 209 N92-10534

TECHLOG (France).

AGILE: An expert system for large space project management p 276 N92-20621

Technical Research Centre of Finland, Tampere.

Quality assurance of safety and risk analysis p 215 N92-18629

Technical Univ. of Istanbul (Turkey).

Numerical simulation of vortex street-edge interaction p 33 N92-13027

Technische Hochschule, Aachen (Germany).

Determination of the structural weight of spacecraft p 135 N92-24387

Hypersonic configurations in slow speed flight p 43 N92-24394

Supersonic flow in compression stages and inlets p 43 N92-24395

Computational techniques for solving the Navier-Stokes equations p 198 N92-27451

Technische Hochschule, Darmstadt (Germany).

Optimality conditions for minimax tasks: An application example from communications engineering [ETN-91-90169] p 156 N92-12156

The stability of graphite brushes at high velocity [ETN-91-90176] p 160 N92-12184

Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity [PREPRINT-1365] p 187 N92-12219

Technische Univ., Aachen (Germany).

On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021

Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479

Technische Univ., Berlin (Germany).

The electronic aeronautical chart for general aeronautics: A system specification [ILR-MITT-263(1991)] p 62 N92-10997

Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993

Examination and mapping of forest damage using remote sensing methods

[ETN-92-91913] p 225 N92-33691

Technische Univ., Brunswick (Germany).

Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010

Project of an adaptive multiaxial autopilot with learning pilot control [ETN-92-90592] p 107 N92-15072

Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926

A multivariable control concept for a gas turbine engine [ETN-92-92104] p 102 N92-33645

Technische Univ., Delft (Netherlands).

Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001

LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 N92-14004

Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045

A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 N92-14321

Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 N92-14325

Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 N92-14326

Why quantify risk? p 153 N92-18637

Reliability, availability, maintainability, and safety p 216 N92-18639

Introduction of the solid fuel combustion chamber project p 142 N92-22269

Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271

Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966

Delfi: Design, development, and applicability of expert systems shells [ISBN-90-6275-734-0] p 259 N92-25306

Vortex dynamics in artificially fabricated superconducting networks [ETN-92-91296] p 160 N92-25307

The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 N92-28579

Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581

Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372

Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414

Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453

A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 N92-30454

Technische Univ., Eindhoven (Netherlands).

On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973

A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 N92-17434

A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479

Technische Univ., Hanover (Germany).

Visualization of instantaneous flows by particle traces p 189 N92-16234

Technische Univ., Munich (Germany).

Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023

Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331

The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335

Calculation of installation effects within performance computer programs p 102 N92-28465

- Numerical simulation of two-dimensional flows by the free-Lagrangian method
[TUM-M9105] p 204 N92-32767
- Technische Univ., Twente (Netherlands).**
Improved shock-capturing of Jameson's scheme for the Euler equations
[PB92-148758] p 196 N92-23251
- Technology Development Corp., Madrid (Spain).**
Electronically steerable antenna for aircraft
p 156 N92-15272
- Thomson-CSF, Malakoff (France).**
Mixed approach towards modular avionics conflicting requirements
p 91 N92-14051
- Interest in real-time simulations for the development terrain following function of radar systems
p 158 N92-28529

U

- Universitaet der Bundeswehr, Hamburg (Germany).**
Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades
[ETN-92-92056] p 205 N92-33910
- Universitaet der Bundeswehr Muenchen, Neubiberg (Germany).**
Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant
p 66 N92-27895
- A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics
[ETN-92-91491] p 49 N92-29741
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements
[ETN-92-91492] p 49 N92-29889
- Universite de Technologie de Compiègne (France).**
A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft
p 196 N92-23846
- Universiteit Twente, Enschede (Netherlands).**
A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence
[MEMO-1009] p 202 N92-29972
- Monopolar vortices as relative equilibria and their dissipative decay
[MEMO-1015] p 202 N92-29977
- University Coll. of North Wales, Bangor.**
Parallel processing applications for gas turbine engine control
p 96 N92-11012
- University Coll. of Swansea (Wales).**
Unstructured grid methods for compressible flows
p 201 N92-27676

V

- VEGA Space Systems Engineering Ltd., Harpenden (England).**
Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCS
p 136 N92-24493
- Veritas Research A.S., Hovik (Norway).**
Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating
p 78 N92-18574
- Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).**
Blade design and analysis using a modified Euler solver
p 97 N92-13952
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] p 188 N92-14328
- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers
p 35 N92-14991
- Computer Graphics and Flow Visualization in Computational Fluid Dynamics
[VKI-LS-1991-07] p 189 N92-16226
- Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors
[VKI-TN-178] p 269 N92-21237
- Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment
p 56 N92-21697
- Boundary Layers in Turbomachines
[VKI-LS-1991-06] p 99 N92-24336
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum
p 196 N92-24343
- Multidimensional upwind methods for unstructured grids
p 201 N92-27675
- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes
p 201 N92-27678

- A frontal approach for node generation in Delaunay triangulations
p 201 N92-27680
- Introduction to Flutter of Winged Aircraft, volume 2
[VKI-LS-1992-01-VOL-2] p 109 N92-34161
- Vrije Univ., Brussels (Belgium).**
A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows
p 188 N92-15026
- An integrated CFD system for 3D turbomachinery applications
p 101 N92-27464
- The USOCs, the resources management, and their links with telescience
p 276 N92-33466

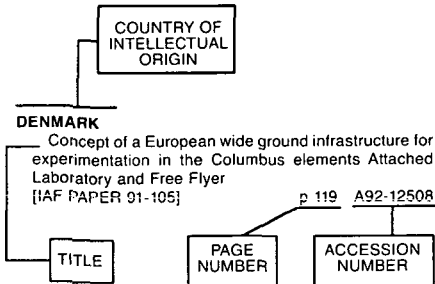
W

- Warsaw Technical Univ. (Poland).**
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization
p 76 N92-13948
- Westinghouse Electric Corp., Baltimore, MD.**
Implications of interoperability and standardization for the industrial base
p 92 N92-14057
- World Meteorological Organization, Geneva (Switzerland).**
Commission for Aeronautical Meteorology. Abridged final report of the ninth session
[WMO-752] p 240 N92-18911

Z

- Zaragoza Univ. (Spain).**
Relegation of the proper rotation in attitude dynamics of a spacecraft
p 138 N92-24728
- Zeiss (Carl), Oberkochen (Germany).**
Airborne experimental FLIR program
p 93 N92-32447

Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

A

AUSTRIA

- Visual natural feature tracking for autonomous spacecraft guidance by symbolic preprocessing and associative memories [IAF PAPER 91-059] p 129 A92-12473
- Modelling stellar surface magnetic fields. I - Search strategies and uniqueness p 283 A92-14147
- Mechanical properties and fracture behaviour of polyimide (SINTIMID) at cryogenic temperatures p 150 A92-25615
- Solving conservation laws with parabolic and cubic splines p 262 A92-27737
- Comments on 'Large-eddy simulation of the up-slope boundary layer' by Ulrich Schumann (April 1990, 116, 637-670) p 236 A92-27800
- Multi-parameter airborne SAR experiments at an Alpine test site p 222 A92-35173
- Axisymmetric laminar interacting boundary layers p 176 A92-42534
- Calculation of three-dimensional turbulent flow in wind tunnel entry section p 19 A92-43055
- Four-dimensional data assimilation - Comparison of variational and sequential algorithms p 239 A92-51783
- Training guidelines in non-destructive testing techniques [DE92-615083] p 217 A92-23258
- Balloons for conjugate cusp studies in the 1990's p 233 A92-26315

B

BELGIUM

- Three dimensional flow in a linear compressor cascade at design conditions [ASME PAPER 91-GT-114] p 8 A92-15565

Spherically symmetric, polytropic flow

- p 284 A92-20810
- CFView - An advanced interactive visualization system based on object-oriented approach [AIAA PAPER 92-0072] p 255 A92-22185
- IGG - An interactive 3D surface modelling and grid generation system [AIAA PAPER 92-0073] p 256 A92-22186
- Numerical computation of internal and external flows. Vol. 2 - Computational methods for inviscid and viscous flows [ISBN 0-471-92351-6] p 166 A92-22624
- Coupled buoyancy and Marangoni convection in acetone - Experiments and comparison with numerical simulations p 167 A92-24760
- USO concept in the member states - Belgium p 119 A92-32466
- Security rights in aircraft under Belgian law p 280 A92-35589
- Base bleed technology in perspective p 17 A92-39427
- Secondary flow investigation inside the passage of a compressor cascade p 19 A92-42124
- A multigrid method for steady incompressible Navier-Stokes equations based on flux difference splitting p 176 A92-43617
- Quantitative heat transfer measurements in hypersonic wind tunnels by means of infrared thermography p 208 A92-54321
- Rib cage shape and motion in microgravity p 247 A92-56944
- Blade design and analysis using a modified Euler solver p 97 A92-13952
- Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] p 188 A92-14328
- Fundamental experimental studies of control effectiveness and heating at hypersonic Mach numbers p 35 A92-14991
- A multiblock/multigrid code for the efficient solution of complex 3D Navier-Stokes flows p 188 A92-15026
- Computer Graphics and Flow Visualization in Computational Fluid Dynamics [VKI-LS-1991-07] p 189 A92-16226
- Visualization of results of mathematical simulations: The contribution of MCG p 190 A92-16236
- Aerodynamically generated acoustic resonance in a pipe with annular flow enlargements and restrictors [VKI-TN-178] p 269 A92-21237
- Aerodynamic effects of de/anti-icing fluids and description of a facility and test technique for their assessment p 56 A92-21697
- Boundary Layers in Turbomachines [VKI-LS-1991-06] p 99 A92-24336
- Boundary layer transition under the presence of discrete frequencies in the freestream turbulence spectrum p 196 A92-24343
- The role of Belgium in Earth observation from space programs p 229 A92-25245
- A heat switch for space cryocooler applications p 160 A92-25852
- Thiocapsa roseopersicina, a bacterium for sulfur-recycling in microbial ecosystems designed for CELSS and space purposes p 244 A92-26977
- An integrated CFD system for 3D turbomachinery applications p 101 A92-27464
- Multidimensional upwind methods for unstructured grids p 201 A92-27675
- Higher order upwind finite volume schemes with ENO-properties for general unstructured meshes p 201 A92-27678
- A frontal approach for node generation in Delaunay triangulations p 201 A92-27680
- The USOCs, the resources management, and their links with telescience p 276 A92-33466
- Introduction to Flutter of Winged Aircraft, volume 2 [VKI-LS-1992-01-VOL-2] p 109 A92-34161
- USE OF natural cometary orbits for spacecraft transfer to Cis-Oort-Space [IAF PAPER 91-719] p 119 A92-20644

Linear panel flutter of an elliptic cylindrical shell

- p 218 A92-21216
- An iterative method for coupled solving of 2D unsteady Navier-Stokes equations p 166 A92-22475
- A method for determining the potential of a spacecraft p 131 A92-23433
- Analysis of a redundant free-flying spacecraft/manipulator system p 132 A92-29704
- Bulgarian effort toward the operational use of passive microwave remote sensing of soil moisture p 222 A92-35007
- A theoretical test of the geostrophic momentum approximation p 237 A92-39471
- Investigation of the structural inhomogeneity of a titanium alloy p 149 A92-47958
- An example of space technological transfer in a small country [IAF PAPER 92-0178] p 282 A92-55636

C

CANADA

- The evaluation of simulator effectiveness for the training of high speed, low level, tactical flight operations p 116 A92-28539

CZECHOSLOVAKIA

- Effect of parametric nonlinearities on the dynamics and tuning of systems with kinematic constraints p 211 A92-11815
- Numerical solution of steady incompressible viscous flows over airfoils p 6 A92-12649
- On the radiant determination of meteors p 283 A92-18593
- The FALSTAFF program - A standard spectrum for simulating the service loading of aircraft with prevailing maneuver loads p 111 A92-21922
- Application of holomorphic vectors theory in three-dimensional potential flow problem p 165 A92-21923
- Simulation of convective temperature oscillations in phase-change processes p 169 A92-29523
- Convergence of telecommunication technologies - Some legal aspects p 281 A92-36682
- Perspectives for the application of the Penaz's method for a non-invasive continuous blood pressure measurement in space medicine p 246 A92-39214
- Finite volume solution of the inviscid compressible fluid flow p 181 A92-50086
- Issues involved in defining outer space, space object and space debris p 282 A92-51856
- Effect of a deicing device on the induced drag of a lifting airfoil p 74 A92-51947
- Discs low cycle fatigue life predictions for gas turbine engines in CSFR by using fractographic information p 215 A92-51950

D

DENMARK

- Concept of a European wide ground infrastructure for experimentation in the Columbus elements Attached Laboratory and Free Flyer [IAF PAPER 91-105] p 119 A92-12508
- Optimization of the flutter load by material orientation p 217 A92-15222
- EEG as screening method in aeromedical selection of air crew p 246 A92-16408
- The control of interface and microstructure of SiC/Al composites by sol-gel techniques p 143 A92-20083
- Terrestrial ionospheric signatures of field-aligned currents p 231 A92-31275
- Polar lows and arctic instability lows in the Bear Island region p 237 A92-32490
- Polar lows affecting Denmark p 237 A92-32491
- The SAS Flight Analysis and Aircraft Monitoring System p 89 A92-35941
- Noise from turbine generators - Noise control, propagation, and assessment p 226 A92-39044
- DANSIM - Danish Airport Noise Simulation Model - Basic principles, experience, and improvements p 227 A92-39055

FINLAND

DANSIM applications - Development of airport noise reduction strategies and environmental policy
p 227 A92-39057

F

FINLAND

Fatigue life analysis for variable-amplitude loading
p 218 A92-19697

Decomposing the atmospheric flow using potential vorticity framework
p 236 A92-21196

A SAR processor for a GIS environment
p 155 A92-34980

Aircraft control for take-off in windshear
p 104 A92-36990

A computerized flight inspection system
p 61 A92-43881

Injuries associated with the use of ejection seats in Finnish pilots
p 247 A92-50292

Vortex nucleation in rotating superfluid He-3-B
p 271 A92-10476

Superfluid vortex nucleation in He-3 flow
p 271 A92-10479

Dynamics of vortices in high-temperature superconductors
p 273 A92-10501

Low pressure impactor with electrical concentration detection
p 209 A92-10534

The measuring modes and observations with the x-ray spectrometer array SIXA onboard spectrum-x-gamma
p 140 A92-10563

CAPS-plasma spectrometer for the Cassini spacecraft
p 140 A92-10565

Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] p 147 A92-14141

Quality assurance of safety and risk analysis
p 215 A92-18629

Vortex motion in rotating superfluid He-3-B
[PB92-134162] p 194 A92-21763

Wave acoustics for propagation of ultrasound along a vortex array in superfluid He-3
[PB92-134147] p 269 A92-21773

Two-dimensional transonic flow calculation by interaction of Euler and boundary layer equations
[PB92-136449] p 42 A92-21784

Modernized MBB panel code: User's guide including background theory
p 43 A92-22233

[PB92-136431] p 43 A92-22233

Vortex lattice-vortex liquid states in anisotropic high-(T sub c) superconductors
[PB92-142421] p 273 A92-22738

Nucleation of vortices at the A-B phase boundary in superfluid He-3: Nonconservation of circulation and vortices with soliton tails in the B phase
[PB92-134170] p 195 A92-22788

Ultrasonic investigation of (3)He-A vortices in low magnetic fields
[PB92-142256] p 265 A92-23665

Stabilized finite element methods for the Stokes problem
[PB92-142298] p 263 A92-24963

TRANSF3: A 3-D grid generator based on transfinite interpolation
[PB92-151919] p 259 A92-25519

Second Meeting of Finnish Space Researchers
[REPT-117(1990)] p 282 A92-25758

Air museum
p 283 A92-25761

Society of space studies
p 283 A92-25762

Millimeter wave technology in space
p 283 A92-25782

Tasks of the council and general secretary of the Commission for Space Industry (Finland)
p 276 A92-25785

International Space University: Experiences and observations during Summer 1989
p 275 A92-25786

Space electronic display panel
p 278 A92-25787

Mutual friction in superfluid He-3: Effects of bound states in the vortex core
[PB92-142231] p 197 A92-26507

The 2D-computation of an axial fan with FINFLO
[PB92-180678] p 203 A92-30023

Exotic states in the cores of quantized vortices for superfluids and superconductors
[DE92-728466] p 206 A92-70151

FRANCE

Vectorising the smooth particle hydrodynamics
p 161 A92-10037

Vigilance in transport operations - Field studies in air transport and railways
p 249 A92-11173

Topology of steady flows of low viscosity fluids
p 162 A92-11219

The enigmatic merging conditions of two-layer baroclinic vortices
p 162 A92-11225

Dynamic characterization and identification of nonlinear systems application to aeronautical structures
p 217 A92-11830

The European ATC challenge
p 58 A92-11877

Analogy between training for dancers and problems of adjustment to microgravity - An evaluation of the subjective vertical in dancers
[IAF PAPER 90-653] p 245 A92-12125

Ariane Transfer Vehicle (ATV) - A generic spacecraft
[IAF PAPER 91-186] p 126 A92-12560

Dispersion curves analysis for bonded plates at low Fd
p 217 A92-13540

Influence of the entropy layer on the separation length in hypersonic aerodynamics in the triple-deck framework.
II p 6 A92-13815

A simplified model for aerodynamic flows around streamlined models
p 6 A92-13816

The Aeronautical Mobile Satellite Service (AMSS). I - Architecture of the AMSS system
p 58 A92-13851

The Aeronautical Mobile Satellite Service (AMSS). II - Frequency spectrum requirements for the Aeronautical Mobile Satellite Service
p 59 A92-13852

The new airport aeronautic meteorological codes
p 235 A92-13855

Experimental study of the atmospheric marine boundary layer from in-situ aircraft measurements (TOSCAN-E-T campaign) - Variability of boundary conditions and eddy flux parameterization
p 235 A92-14052

Studying dynamic behavior of X380 helicopter equipped with a new 5-blade composite rotor
p 67 A92-14398

P120 programme - First results of the pre-development phase
p 1 A92-14447

Oriflamme - A reference airbreathing launcher to highlight areas that are technological drivers for hypersonic vehicles
[IAF PAPER 91-207] p 126 A92-14705

Ground operations of a HTOL airbreathing launcher
[IAF PAPER 91-217] p 125 A92-14708

Hermes-space station phasing strategies optimization
[IAF PAPER 91-345] p 130 A92-14751

Use of composite materials for aeronautical structure
p 143 A92-15303

Direct simulation of three-dimensional turbulence in the Taylor-Green vortex
p 162 A92-15483

Effects of long duration spaceflight on human T lymphocyte and monocyte activity
p 245 A92-15956

Point measurement of surface temperature in a hypersonic wind tunnel using photoluminescence
[ONERA, TP NO. 1991-94] p 206 A92-16077

Aircraft ground vibration test by means of flight control surfaces
[ONERA, TP NO. 1991-96] p 103 A92-16079

Lightning activity in microburst producing storm cells
[ONERA, TP NO. 1991-98] p 235 A92-16080

Three-dimensional calculations of reactive flows in aircraft combustion chambers performed using two combustion models
[ONERA, TP NO. 1991-110] p 163 A92-16089

Prediction of generalized aerodynamic forces following linearized supersonic theory
[ONERA, TP NO. 1991-114] p 9 A92-16093

High-speed impulsive noise and aerodynamic results for rectangular and swept rotor blade tip tests in S1-Modane wind tunnel
[ONERA, TP NO. 1991-124] p 9 A92-16102

Three-dimensional thin-layer and space-marching Navier-Stokes computations using an implicit MUSCL approach - Comparison with experiments and Euler computations
[ONERA, TP NO. 1991-131] p 9 A92-16107

Environmental impact of a future supersonic transport aircraft
[ONERA, TP NO. 1991-132] p 226 A92-16108

Recent development of wind-tunnel test techniques at ONERA
[ONERA, TP NO. 1991-135] p 110 A92-16110

Behavior of a suspension in the presence of a potential vortex
[ONERA, TP NO. 1991-140] p 163 A92-16114

Detailed analysis of wing-nacelle interaction for commercial transport aircraft
[ONERA, TP NO. 1991-152] p 9 A92-16122

Aerosol behavior in supersonic flows
[ONERA, TP NO. 1991-155] p 206 A92-16124

Formulation of a simplified model of rotor-horizontal stabilizer interactions and comparison with experimental measurements
[ONERA, TP NO. 1991-157] p 9 A92-16125

Thermomechanical model of the linkage between an I.R. window and the housing device
[ONERA, TP NO. 1991-158] p 131 A92-16126

Utilization of a research simulator for the development of new flight control concepts
[ONERA, TP NO. 1991-161] p 110 A92-16128

FOREIGN TECHNOLOGY INDEX

The sonic boom and problems related to supersonic flights of military aircraft
[ONERA, TP NO. 1991-162] p 9 A92-16129

Supersonic stator-rotor interaction in a turbine stage
[ONERA, TP NO. 1991-166] p 10 A92-16133

Aerodynamic measuring techniques for transonic and supersonic flow in cascades and turbomachines
[ONERA, TP NO. 1991-170] p 110 A92-16135

Theoretical study and prediction of BVI noise including close interactions
[ONERA, TP NO. 1991-174] p 265 A92-16138

Solution of the compressible Euler equations for steady flows around helicopter rotor blades by an implicit space-centered method
[ONERA, TP NO. 1991-177] p 10 A92-16139

Aerodynamic and acoustic calculations of transonic nonlifting hovering rotors
[ONERA, TP NO. 1991-178] p 10 A92-16140

Numerical optimization of helicopter rotor blade airfoils using unsteady aerodynamic calculations
[ONERA, TP NO. 1991-187] p 10 A92-16141

Concept for future cockpits
p 88 A92-16148

Relativistic electron-positron beam formation in the framework of the two-flow model for active galactic nuclei
p 284 A92-16523

A 1D exact treatment of shock waves within spectral methods in plane geometry
p 164 A92-17432

Solar wind speed profiles over forested boundary layer during the Hapex-Mobility campaign
p 235 A92-17729

STS 2000 - A reference airbreathing SSTO
[AIAA PAPER 91-5013] p 126 A92-17811

Engine-airframe integration for aerospace planes - Lessons from STS 2000 and STAR-H studies
[AIAA PAPER 91-5039] p 94 A92-17827

Potential hypersonic vehicles applications
[AIAA PAPER 91-5086] p 1 A92-17854

Evaluation of spontaneous baroreflex response after 28 days head down tilt bedrest
[IAF PAPER 91-550] p 246 A92-18547

Ada
p 255 A92-19395

Aerospace Software Engineering in France
p 255 A92-19404

Final equilibrium state of a two-dimensional shear layer
p 164 A92-19967

Lightning strike simulation using coaxial line technique and 3D linear injection current analysis
p 159 A92-20131

Direct simulation and modeling of premixed turbulent combustion
p 147 A92-20344

Real-time mechanisms in a multibase knowledge system
p 264 A92-20345

An influence-matrix formulation of the Navier-Stokes equations in velocity-vorticity variables for incompressible flows
p 164 A92-20724

An approximate method for treating a turbulent boundary layer with symmetry of revolution
p 164 A92-21306

Concerning the functional solution of transonic flows
p 11 A92-21318

Measurement of convective heat-transfer coefficients on a wind tunnel model by passive and stimulated infrared thermography
p 206 A92-21450

Empirical determination of universal multifractal exponents in turbulent velocity fields
p 165 A92-21461

Model and computation of discrete jets in crossflow
p 165 A92-21505

On the Arnol'd stability criterion for steady-state flows of an ideal fluid
p 165 A92-21506

The position of the unsteady flow computation in the compressor and turbine design and analysis process
[AIAA PAPER 92-0015] p 94 A92-22137

International standardisation of regulations for gust loading calculations
p 68 A92-22473

The beta-CEZ - A high performance titanium alloy for aerospace engines
p 148 A92-22760

Architecture and interconnects of programmable processors of radar signals
p 159 A92-23042

Status and user characterization of parallel machines for digital simulation
p 260 A92-23046

The role of dissipation mechanisms in the nonlinear dynamics of unstable baroclinic waves
p 166 A92-23292

Effects of ionizing and nonionizing radiation on aircraft
p 159 A92-23301

Industrial measurement of microphysical parameters - Application to natural and simulated icing clouds
p 53 A92-23302

Navier-Stokes computation of airfoil in stall using algebraic Reynolds-stress model
[AIAA PAPER 92-0195] p 11 A92-23803

The Hermes search and rescue operations in the open sea
[AIAA PAPER 91-4099] p 128 A92-24357

Influence of flight parameters on air intake internal flow distortions due to gun blast-air interaction
p 12 A92-24426

- Establishment and characterization of a reproducible vortex for use in studying nonsteady two-dimensional phenomena p 12 A92-24428
- A discontinuous h-p Galerkin approximation of potential flows p 166 A92-24429
- Measurement of convective heat-transfer coefficients in wind tunnels using passive and stimulated infrared thermography p 167 A92-24430
- Parametric aerodynamic design of spinning finned projectiles using a matrix interpolation method p 12 A92-24655
- A cognitive temporal model for the planning in aircraft maintenance p 1 A92-25178
- Interaction of a flame front with its self-generated flow in an enclosure - The 'tulip flame' phenomenon p 147 A92-25475
- Recent progress in reactive flow computations p 167 A92-26220
- Numerical simulation of transition to turbulence in free-shear layers p 167 A92-26221
- On the numerical treatment of nonlinear source terms in reaction-convection equations p 168 A92-26269
- [AIAA PAPER 92-0419] p 168 A92-26269
- Combat aircraft jet engine noise studies p 266 A92-26353
- [ONERA, TP NO. 1991-192] p 266 A92-26353
- Parallel computing - An indispensable tool for the numerical simulation of tomorrow p 255 A92-26355
- [ONERA, TP NO. 1991-196] p 255 A92-26355
- Experimental and theoretical studies on helicopter rotor fuselage interaction p 13 A92-26356
- [ONERA, TP NO. 1991-197] p 13 A92-26356
- Theoretical and experimental studies of helicopter rotor/fuselage interaction p 13 A92-26357
- [ONERA, TP NO. 1991-198] p 13 A92-26357
- Aircraft icing p 54 A92-26359
- [ONERA, TP NO. 1991-202] p 54 A92-26359
- Productivity and quality in the Modane and Fauga wind tunnels - Prospects for the 90s p 111 A92-26360
- [ONERA, TP NO. 1991-203] p 111 A92-26360
- Aircraft lightning strikes p 54 A92-26361
- [ONERA, TP NO. 1991-204] p 54 A92-26361
- Experimental study of the effects of atmospheric turbulence on sound propagation over the ground p 266 A92-26363
- [ONERA, TP NO. 1991-211] p 266 A92-26363
- Wall pressure wavenumber-frequency spectrum beneath a turbulent boundary layer measured with transducer arrays calibrated with an acoustical method p 13 A92-26364
- [ONERA, TP NO. 1991-212] p 13 A92-26364
- Numerical flow visualization of high Reynolds number recirculated flows using an animation technique p 168 A92-26367
- [ONERA, TP NO. 1991-215] p 168 A92-26367
- From concept to model: Conception and evaluation of an architecture for a distributed system with SAHARA - Some reflections on results of the utilization of SAHARA in the framework of the Electronic Copilot p 260 A92-26368
- [ONERA, TP NO. 1991-216] p 260 A92-26368
- Aerodynamic computations of high-speed transonic propellers p 13 A92-26370
- [ONERA, TP NO. 1991-218] p 13 A92-26370
- Tests of models equipped with a turbofan powered simulator in the ONERA F1 low-speed pressurized wind tunnel p 111 A92-26371
- [ONERA, TP NO. 1991-219] p 111 A92-26371
- CARS temperature measurements and validation of a computing code on a gas-turbine combustor p 94 A92-26376
- [ONERA, TP NO. 1991-224] p 94 A92-26376
- Validation of a 3D Navier-Stokes code on experimental compressor bladings p 13 A92-26381
- [ONERA, TP NO. 1991-229] p 13 A92-26381
- Multigrid and ADI techniques to solve unsteady 3D viscous flow in Velocity-Vorticity formulation p 168 A92-26386
- [ONERA, TP NO. 1991-235] p 168 A92-26386
- Numerical simulation of nonreactive flows with transverse jet using Euler and laminar Navier-Stokes codes p 13 A92-26387
- [ONERA, TP NO. 1991-237] p 13 A92-26387
- Supersonic transport in the 21st century p 2 A92-26793
- The cockpit of a modern aircraft - The Airbus A340 considered as an example p 69 A92-26849
- Space environment: Prevention of risks related to spacecraft charging; International Course on Space Technology, Toulouse, France, Nov. 26-30, 1990, Proceedings p 131 A92-27130
- [ISBN 2-85428-288-4] p 131 A92-27130
- The sun, the solar wind, and cosmic rays p 285 A92-27131
- Determination of the aerodynamic flow about a reentry body at high altitude p 14 A92-28975
- Study of a class of two-point box schemes with application to one-dimensional fluid dynamics p 170 A92-29998
- Generalized expression of chorochronic periodicity in turbomachinery blade-row interaction p 14 A92-30000
- Direct and large-eddy simulations of transition in the compressible boundary layer p 170 A92-31196
- Two-dimensional patterns in Rayleigh-Taylor instability of a thin layer p 170 A92-31461
- Generation, optimization and adaptation of multiblock grids around complex configurations in computational fluid dynamics p 171 A92-31488
- [ONERA, TP NO. 1992-30] p 171 A92-31488
- French research and technology program on advanced hypersonic propulsion p 94 A92-31683
- [AIAA PAPER 91-5003] p 94 A92-31683
- Benefits of electric propulsion for orbit injection of communication spacecraft p 140 A92-31709
- [AIAA PAPER 92-1955] p 140 A92-31709
- Use of relative humidity sensors for planes measurement p 89 A92-32080
- Design of penetration-oriented MARV p 127 A92-33195
- [AIAA PAPER 92-1003] p 127 A92-33195
- Explicit guidance law for manned spacecraft p 123 A92-33286
- [AIAA PAPER 92-1145] p 123 A92-33286
- Simulation of 2D external viscous flows by means of a domain decomposition p 171 A92-33466
- Structural optimization at Aerospatiale Aircraft p 256 A92-34542
- [AIAA PAPER 92-2371] p 256 A92-34542
- Measurements of ocean wave spectra with the RESSAC airborne radar p 89 A92-35256
- Highlighting various tax and security law aspects of aircraft financing - France p 280 A92-35592
- The development of a new light, single engine helicopter family p 70 A92-35734
- EUROFAR airframe aerodynamic design p 70 A92-35750
- Generalized higher harmonic control - Ten years of Aerospatiale experience p 104 A92-35769
- Aerospatiale experience p 104 A92-35769
- Design and manufacturing of torsional flexible blade models p 71 A92-35780
- The effects of wall suction on laminar-turbulent transition in three-dimensional flow p 15 A92-36021
- Characterization by XPS and SEM of reactive chemical vapour deposited boron carbide on carbon fibre p 150 A92-36292
- Numerical study of an oscillating cylinder in uniform flow and in the wake of an upstream cylinder p 172 A92-36347
- Asymptotic defect boundary-layer theory applied to hypersonic flows p 15 A92-36839
- The French space program for earth observation p 222 A92-37154
- Aircraft experiments with visible and infrared sensors p 206 A92-37159
- Performance of turbulence models to predict supersonic boundary layer flows p 16 A92-37553
- Characterization of active fires in West African savannas by analysis of satellite data - Landsat Thematic Mapper p 222 A92-37633
- Relaxation of Euler equations and hydrodynamic instabilities p 173 A92-38897
- Noise inside aircraft fuselages subjected to airborne excitation p 72 A92-39089
- Active control of pulsed flow for low frequency noises attenuation p 267 A92-39109
- Cardiac hemodynamics and orthostatic stress - Influence of different types of physical training p 246 A92-39180
- Computer codes for ballistic performance calculations of base bleed propellant grain p 17 A92-39433
- The Space Exploration Initiative and the Aero-Space Plane Launcher p 120 A92-39510
- ELS for the A340 p 89 A92-39963
- [SAE PAPER 912111] p 89 A92-39963
- Rafale: Program update - Development of a naval version p 72 A92-40035
- Large eddy simulation applied to the modelling of particulate transport coefficients in turbulent two-phase flows p 173 A92-40089
- A theoretical and numerical investigation of wave-turbulence interactions p 173 A92-40097
- Influence of suction through a slot on a turbulent boundary layer p 18 A92-40127
- Experimental and numerical investigation of a turbulent boundary layer over riblets p 18 A92-40128
- Compressibility effects in turbulent far wakes p 18 A92-40140
- The effects of viscosity and diffusion on a supersonic mixing layer p 18 A92-40143
- Reactive mixing layer between pressure reflecting boundaries p 95 A92-40144
- Structure and modelling in strongly sheared turbulent compressible flow p 175 A92-40161
- Numerical simulation and modelling of the transition past a rectangular afterbody p 175 A92-40170
- SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Ecole Supérieure d'Electricité, Gif-sur-Yvette, France, Aug. 27-30, 1991 p 226 A92-40401
- Problems experienced by man when constructing giant structures in space p 251 A92-40438
- Different space electrochemical conversion and storage systems p 140 A92-40455
- Basic experiment on a supersonic vortex flow around a missile body p 19 A92-41545
- The numerical dynamic for highly nonlinear partial differential equations p 175 A92-41814
- Models of turbulence in a hypersonic boundary layer p 19 A92-41817
- Generalities on the ramjet p 95 A92-41819
- The turbo-ramjet Griffon p 286 A92-41820
- The ASMP program p 3 A92-41823
- An overview of boundary integral formulations for potential flows in fluid-fluid systems p 175 A92-41875
- Apogee manoeuvre strategies for the Inmarsat-2 spacecraft p 123 A92-43262
- [AAS PAPER 91-364] p 123 A92-43262
- Acoustic transmission through a 2-D orthotropic multi-layered infinite cylindrical shell p 267 A92-44197
- Instantaneous visualization of surface flows p 207 A92-44327
- Rotational temperature measurements in an arc jet p 177 A92-44395
- Vigilance of aircrews during long-haul flights p 247 A92-45021
- Knowledge transfer and support systems in fighter aircraft p 251 A92-45047
- Knowledge transfer and anticipation in airline piloting p 250 A92-45065
- Wavelet transforms and their applications to turbulence p 177 A92-45091
- Hydrodynamic instabilities and turbulence - The approach at CEA-DAM p 177 A92-45093
- Modelling compressible turbulent mixing p 178 A92-45094
- A spectral model for turbulent transport p 178 A92-45095
- Instantaneous measurement of density from double simultaneous interferograms p 207 A92-45129
- An improved approach for the computation of transonic/supersonic flows with applications to aerospace configurations p 20 A92-45487
- [AIAA PAPER 92-2613] p 20 A92-45487
- A new automatic grid generation environment for CFD applications p 21 A92-45558
- [AIAA PAPER 92-2720] p 21 A92-45558
- Spectral large-eddy simulation of isotropic and stably stratified turbulence p 178 A92-46254
- Nonlinear Galerkin method and subgrid-scale model for two-dimensional turbulent flows p 179 A92-46442
- Experimental and numerical study of flow around helicopter rotor blade tips p 22 A92-46948
- Experimental and computational studies of hovering rotor flows p 22 A92-46954
- Rotational temperature measurements of N₂(+) in an arc jet at low pressure p 273 A92-46982
- [AIAA PAPER 92-2967] p 273 A92-46982
- Application of a variational method in compressible flow computations p 179 A92-47070
- Geometrical control of the first coordinate surface off the boundary p 262 A92-47075
- Unstructured multigridding by volume agglomeration - Current status p 179 A92-47157
- Model of anomalous transport with backreacting localized perturbations p 265 A92-47422
- Industrial practice in aeronautical maintenance p 3 A92-47774
- Numerical and experimental investigation of rarefied compression corner flow p 23 A92-47876
- [AIAA PAPER 92-2900] p 23 A92-47876
- A numerical simulation of injection of droplets in a compressible flow p 180 A92-47899
- [AIAA PAPER 92-2929] p 180 A92-47899
- Some direct methods in electromagnetism p 265 A92-47921
- A340 handling, cockpit design improve on predecessor A320 p 73 A92-47969
- Direct estimates of universal multifractal indices for wind and temperature fields p 180 A92-48200
- Radar-optronic tracking experiment for short and medium range aerial combat p 61 A92-48468
- Calculation of fully three-dimensional separated flows with an unsteady viscous-inviscid interaction method p 23 A92-48577
- [ONERA, TP NO. 1992-1] p 23 A92-48577
- Advanced superalloys for turbine blade and vane applications p 149 A92-48578
- [ONERA, TP NO. 1992-2] p 149 A92-48578
- Separation and vortex formation in turbulent flows p 24 A92-48579
- [ONERA, TP NO. 1992-7] p 24 A92-48579
- The design and testing of an airfoil with hybrid laminar flow control p 24 A92-48585
- [ONERA, TP NO. 1992-22] p 24 A92-48585
- The A320 laminar fin programme p 73 A92-48586
- [ONERA, TP NO. 1992-23] p 73 A92-48586
- Trends in commercial aircraft design - What evolution factors and what approach? p 4 A92-48587
- [ONERA, TP NO. 1992-25] p 4 A92-48587

- Research on helicopter rotors - Progress in aerodynamics, aeroelasticity and acoustics [ONERA, TP NO. 1992-27] p 73 A92-48589
- Numerical analysis of an engine turbine disk loaded with a large number of thermomechanical cycles [ONERA, TP NO. 1992-31] p 218 A92-48592
- Study of noise generated by the impingement of a hot supersonic jet on an obstacle [ONERA, TP NO. 1992-33] p 267 A92-48594
- Characterization of subcritical and supercritical jets by an acoustic imagery method [ONERA, TP NO. 1992-34] p 267 A92-48595
- Calculation of noise generated in flows on the basis of an aerodynamic/acoustic decomposition [ONERA, TP NO. 1992-35] p 267 A92-48596
- New hypersonic test methods developed at ONERA - The R5 and F4 wind tunnels [ONERA, TP NO. 1992-39] p 111 A92-48600
- Influence of geometrical parameters on helicopter rotor high speed impulsive noise [ONERA, TP NO. 1992-40] p 267 A92-48601
- Experimental and theoretical investigation of a homogeneous turbulent shear flow [ONERA, TP NO. 1992-43] p 180 A92-48604
- Indirect measurements of convective flow by IR thermography [ONERA, TP NO. 1992-46] p 207 A92-48607
- Advances in aircraft modal identification [ONERA, TP NO. 1992-47] p 105 A92-48608
- Aluminides modified by palladium - Protection of new parts by local finishing [ONERA, TP NO. 1992-49] p 149 A92-48610
- Modeling and computation of composite materials [ONERA, TP NO. 1992-50] p 144 A92-48611
- Elasto-acoustic damped vibrations - Finite element and modal reduction methods [ONERA, TP NO. 1992-52] p 218 A92-48613
- Navier-Stokes computation over a three-dimensional ramp [ONERA, TP NO. 1992-55] p 181 A92-48616
- Modeling of a vortex in turbulent incompressible flow [ONERA, TP NO. 1992-60] p 181 A92-48619
- Advanced CFD simulation and testing of compressor blading in the multistage environment [AIAA PAPER 92-3040] p 24 A92-48701
- Advanced spacecraft concepts using electrical propulsion [AIAA PAPER 92-3513] p 132 A92-49046
- Is the avionics system of the Hermes Spaceplane centralized or decentralized? p 139 A92-49258
- Computer software in civil aircraft p 256 A92-49302
- Flight management system back-up navigation for the A330/A340 aircraft p 106 A92-49326
- Navier-Stokes computations of horseshoe vortex flows p 181 A92-49516
- A hot wire method for measuring turbulence in transonic or supersonic heated flows p 207 A92-50037
- Single alexandrite laser source for airborne DIAL system p 210 A92-51228
- Successful transfer of technology from a research and development laboratory to an Aerospace production unit p 4 A92-51808
- Some problems of the stability of a system of three vortices p 182 A92-51893
- Sulfur emission, CCN, clouds and climate - A review p 239 A92-52354
- Adaptive spectral methods with application to mixing layer computations p 182 A92-52404
- Transport phenomena in relaxing gas mixtures - Models and applications p 274 A92-52739
- Transport coefficients in discrete kinetic theory and comparison with classical fluid dynamics p 274 A92-52782
- Solution of Euler equations with unstructured mesh - 3-D case p 26 A92-52973
- Hot-wire measurements in turbulent transonic flows p 26 A92-53078
- Remarks on the relation between lift induced drag and vortex drag p 26 A92-53079
- Human factors and simulation p 55 A92-53236
- Monopulse secondary surveillance radar and the mode-S surveillance system p 62 A92-53239
- The French space programme p 121 A92-53458
- European Space Agency - Achievements and perspectives p 121 A92-53459
- Objective representation, and analysis, of force lines of a vector field tangent to a skewed surface p 263 A92-54574
- Mechanisms of high-current pulses in lightning and long-spark stepped leaders [ONERA, TP NO. 1992-202] p 159 A92-54678
- State of composite material structure control in situ p 215 A92-54862
- Diagnostics of thermal spraying plasma jets p 213 A92-55403
- Hermes nominal reentry trajectories [IAF PAPER 92-0018] p 124 A92-55516
- Open and closed loop guidance for an airbreathing winged launch vehicle [IAF PAPER 92-0042] p 127 A92-55537
- France and the Peenemuende legacy [IAF PAPER 92-0186] p 286 A92-55641
- Advanced carbon/carbon planetary entry decelerator development and hardware verification [IAF PAPER 92-0327] p 128 A92-55748
- How to circulate official terminology [IAF PAPER 92-0346] p 277 A92-55761
- Activities relating to space terminology in France [IAF PAPER 92-0348] p 277 A92-55762
- Towards an electronic dictionary of the space technical domain [IAF PAPER 92-0354] p 277 A92-55764
- Main activities conducted under the International Space Year Panel of Experts on Education and Applications [IAF PAPER 92-0466] p 274 A92-55806
- Manned missions to Mars - What scenarios for Europe? [IAF PAPER 92-0534] p 121 A92-55842
- The technical evolution of ground flight dynamics system utilized for spacecraft operations [IAF PAPER 92-0546] p 125 A92-55850
- Experimental study of noise generation and propagation in a turbofan model [ONERA, TP NO. 1992-199] p 268 A92-56169
- The computation and validation of hovering rotor performance p 74 A92-56285
- The Eurofar program - An European overview on advanced VTOL civil transportation system p 4 A92-56299
- Organization and technical status of the NH90 European helicopter programme p 4 A92-56306
- AS 332 MKII - Development and certification p 75 A92-56343
- The SR3 low density wind tunnel - Facility capabilities and research development [AIAA PAPER 92-3972] p 112 A92-56798
- A research and technology program for the benefit of the Ariane family [IAF PAPER 92-0873] p 127 A92-57262
- SETI in France [IAF PAPER 92-1023] p 282 A92-57345
- Numerical simulation of vortex breakdown by solving the Euler equations for an incompressible fluid p 185 A92-10163
- Numerical simulation of vortex breakdown via 3-D Euler equations p 185 A92-10164
- Numerical resolution of three dimensional Euler equations in totally unstructured mesh [CERT-RF-1/3369-00/DERI-GAN] p 28 A92-10988
- Three dimensional numerical method for resolving small transonic perturbations in unstructured mesh [ONERA-RT-56/3064-RY-006-R] p 28 A92-10989
- Rotorcraft system identification [AGARD-AR-280] p 75 A92-11001
- Wing tip turbine: Analysis of the results of S2MA sounding of marginal vortex of the A320, technical summary [ONERA-RTS-21/4365-AY-056A] p 76 A92-11009
- Application of infrared thermography to thermal flux measurement in wind tunnels [AAAF-NT-89-12] p 112 A92-11020
- Preliminary studies for automizing thermal flux measurement examination by thermosensitive coloring [AAAF-NT-89-28] p 185 A92-11288
- Secondary instability of the three dimensional laminar boundary layer in incompressible flow: Description of the calculation code [CERT-RT-63/5618-54] p 185 A92-11306
- Resolution of the Navier-Stokes equations applied to the computation of the laminar flow around a two dimensional wing profile [CERT-RT-65/5604-35] p 185 A92-11307
- Hydrodynamic tunnel study of the marginal vortex breakdown in the pressure field of a wing profile [ONERA-RSF-44/1147-AY-144A] p 185 A92-11308
- Resolution of Navier-Stokes equations around profiles: Drag evolution [ONERA-RTS-86/1685-AY-156A] p 186 A92-11310
- TIMS calibration correction by comparison with PRT5 p 223 A92-11412
- Aircraft simulations of the POLDER experiment: First results p 223 A92-11471
- Using the radiative surface temperature in energy budget studies over plant canopies p 223 A92-11506
- Eighty years of aerospace technique through ATMA bulletins [ETN-91-90097] p 286 A92-11963
- Thermographic gust wind tunnel measurements [ONERA-RF-31/3409-PY] p 29 A92-11972
- Compression ramp in rarefied gas [RC-90-08] p 29 A92-11978
- Flat planes in rarefied hypersonic flows [SESSIA-430/91-940] p 29 A92-11979
- Nonstationary flight aerodynamics in a turbulent environment [ETN-91-90102] p 29 A92-11980
- Control aspects of the transition from transversal to transonic flow, step effects [ETN-91-90108] p 29 A92-11981
- Phenomenological modeling of the wake produced by a straight two dimensional base in subsonic flow [REPT-90/59] p 29 A92-11982
- Study of interactions on anemoclinometric sensors [REPT-90/30] p 113 A92-12006
- Nondestructive testing of oxidation protected carbon/carbon materials [REPT-911-430-136] p 145 A92-12065
- ACLICO: An aid system for designing bonded joints [REPT-911-430-134] p 152 A92-12146
- Boundary layer transition [CERT-RTS-55/5018-45] p 186 A92-12210
- Turbulence control by intake [CERT-RF-67/5004-37] p 186 A92-12211
- Study of a technique of low level turbulence detection [ETN-91-90107] p 186 A92-12215
- Study of detached turbulent flow in an air intake by means of high speed tomography and laser velocimetry [REPT-90/55] p 187 A92-12216
- Formal specification of satellite telemetry: A practical experience p 129 A92-12456
- A practical experience of Ada for developing embedded software p 257 A92-12465
- Machine Intelligence for Aerospace Electronic Systems [AGARD-CP-499] p 261 A92-12517
- Vortex Flow Aerodynamics [AGARD-CP-494] p 30 A92-12996
- Characteristics of a boundary layer in a leading edge vortex p 31 A92-13012
- Vortex flow on a missile body: Experimental study and modeling p 32 A92-13013
- Determination of vortex-breakdown criteria by solving the Euler and Navier-Stokes equations p 32 A92-13018
- Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine [AGARD-AG-324] p 244 A92-13547
- The pilot flight surgeon bond p 250 A92-13548
- Fear of flying p 251 A92-13556
- AGARD highlights 91/2 [ISBN-92-835-0634-0] p 286 A92-13916
- Recent progress in inverse methods in France p 97 A92-13938
- The turbomachine blading design using S2-S1 approach p 97 A92-13940
- Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] p 76 A92-14042
- The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] p 91 A92-14046
- Avionics standardization in Europe p 91 A92-14050
- Mixed approach towards modular avionics conflicting requirements p 91 A92-14051
- Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE] p 156 A92-14268
- Aerothermodynamics for Space Vehicles [ESA-SP-318] p 33 A92-14973
- Hypersonic boundary layers: Transition and turbulence effects p 188 A92-14976
- Analysis tools of ONERA and DLR for the aerothermodynamics of reentry vehicles p 133 A92-14977
- Experimental investigation of transverse jet effects related to hypersonic space vehicles p 36 A92-14995
- Numerical simulations around models in hypersonic wind tunnels p 36 A92-14998
- Heat transfer measurements in ONERA supersonic and hypersonic wind tunnels using passive and active infrared thermography p 114 A92-15003
- Ablation and temperature sensors for flight measurements in reentry body heat shields p 209 A92-15004
- Hypersonic viscous shock layer in thermochemical nonequilibrium p 37 A92-15014
- Numerical simulation of non-equilibrium viscous flows in hypersonic nozzles p 37 A92-15018
- Hypersonic inviscid flow field simulations around reentry vehicles with flap deflection p 38 A92-15025
- Numerical simulation of thermochemical non-equilibrium viscous flows around reentry bodies p 188 A92-15029
- Transitional flows around re-entry bodies p 38 A92-15035
- Computation of aerodynamic coefficients on Hermes-Ariane5 configuration p 38 A92-15040

- Normalization, reliability and validation of information for spatial operations p 157 N92-15285
Activities report of the European Space Agency [ETN-92-90679] p 286 N92-15961
Interactive visualization of CFD results ASCETE p 190 N92-16235
Calendar of selected aeronautical and space meetings, July 1990 onwards [AGARD-CAL-90/2] p 275 N92-17198
Calendar of selected aeronautical and space meetings, January 1992 and onwards [AGARD-CAL-92/1] p 275 N92-17212
Fatigue safety factor: Assessment of associated safety level p 220 N92-18573
Fatigue testing and tear down operations on Airbus A320 forward fuselage p 78 N92-18579
Aircraft tracking optimization of parameters selection p 79 N92-18585
Space Product Assurance for Europe in the 1990s: An ESA Symposium [ESA-SP-316] p 152 N92-18607
International collaboration in PA and safety, the Eurospace PA-Panel p 215 N92-18608
Organisational robustness for manned space flight p 152 N92-18618
Criticality management in space programs p 275 N92-18619
Systems safety: Practical evaluation of sneak circuit analysis applied to case studies p 160 N92-18630
Future technologies for space: New product assurance concepts p 153 N92-18650
Intellectual Property Rights [AGARD-LS-181] p 277 N92-18659
Transfers of technology: International negotiations and work in progress p 278 N92-18665
Manoeuvring Aerodynamics [AGARD-CP-497] p 80 N92-18778
Characterization of unsteady aerodynamic phenomena at high angles p 80 N92-18787
High Altitude and High Acceleration Protection for Military Aircrew [AGARD-CP-516] p 247 N92-18972
G-LOC, Gz and brain hypoxia. Gz/s and intracranial hypertension p 248 N92-18984
Circulatory biomechanics effects of accelerations p 248 N92-18991
French equipment for integrated protection of combat aircraft crews: Principles and tests at high altitudes p 252 N92-18994
Physiological protection equipment for combat aircraft: Integration of functions, principal technologies p 252 N92-18996
Helmet Mounted Displays and Night Vision Goggles [AGARD-CP-517] p 252 N92-19008
Does the future lie in binocular helmet display? p 253 N92-19019
A deficit approach to three dimensional incompressible flows [CERT-RF-39/5025-36] p 192 N92-19294
Double loop control law strategy and applications to helicopter [CERT-2/7724-DEFA] p 108 N92-19295
Inhomogeneous turbulence beyond spectral equilibria: Aeronautical applications [ETN-92-90867] p 192 N92-19349
Catalogue of ESA patents [ESA-SP-1131-REV-1] p 287 N92-19411
Promotion of industrial development and utilisation of microgravity in space: The Radius report [ESA-BR-76] p 152 N92-19413
Drag prediction using computation methods [ONERA-RSF-82/1685-AY-154-4] p 41 N92-19682
Hypersonic wakes [ETN-92-91082] p 41 N92-19925
Development of an electromyography and accelerometry ambulatory recording system [CERB-91-07] p 253 N92-19926
Fundamental study of shock wave/turbulent boundary layer interaction with passive control in transonic flow [ONERA-NT-1991-9] p 193 N92-19932
Validation of flight critical control systems [AGARD-AR-274] p 108 N92-20026
Formation and stability of a semi-infinite vorticity line under an adherence condition [ETN-92-91075] p 193 N92-20230
Marco contract report [ETN-92-91077] p 193 N92-20232
Photoluminescence thermography: Pinpoint study of a linear luminophore; laboratory evaluation; and preliminary gust wind tunnel tests [ONERA-RSF-128/1865-AY-726A] p 115 N92-20385
Definition of acoustic measurements in the anechoic chamber of Palaiseau (France) and the wind tunnel at Nantes (France) [ONERA-RT-16/3641-PY] p 269 N92-20387
Atmospheric transmission of polar meteorites [ONERA-NT-1991-5] p 284 N92-20477
Space software is first of all software p 258 N92-20590
Simulation and control of large software projects p 258 N92-20615
AGILE: An expert system for large space project management p 276 N92-20621
Launch Bases and Control Infrastructures for Spacecraft [ESA-SP-342] p 125 N92-20715
Design evolution of the Ariane launching installations p 126 N92-20726
Hermes: Astronaut safety during launching and reentry phases p 126 N92-20774
Control of the destruction of a logistic vehicle at reentry p 126 N92-20778
Operational safety of a Kourou (French Guiana) Ariane launch base ground system p 126 N92-20786
Air intakes for high speed vehicles [AGARD-AR-270] p 41 N92-20797
Effects of Adverse Weather on Aerodynamics [AGARD-CP-496] p 55 N92-21679
Flight in adverse environmental conditions p 55 N92-21680
Regulations and their changes for certification of civil aircraft in icing conditions p 56 N92-21683
Prediction of helicopter noise: Adaptation of noise load calculations to the blade-vortex interaction [ONERA-RS-97/5094-PY] p 269 N92-21736
Existence of non-topological solitons in the self-dual Chern-Simons theory [PB92-134402] p 271 N92-21788
Aircraft Ship Operations [AGARD-CP-509] p 81 N92-21951
Integration of flight and carrier landing aid systems for shipboard operations p 64 N92-21958
Approach and landing assisted by onboard image processing p 64 N92-21959
Dynamic performance of an aircraft on its landing gear: Test and evaluation on a dihedral p 82 N92-21970
Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-R-784] p 83 N92-23227
Structural optimization of aircraft practice and trends p 83 N92-23239
Launcher Propulsion Towards the Year 2010 [ESA-SP-327] p 127 N92-23750
Spacecraft Structures and Mechanical Testing, volume 1 [ESA-SP-321-VOL-1] p 133 N92-23780
Dynamic load cases on Ariane 5 p 127 N92-23797
Large thin composite thermostructural parts p 134 N92-23821
Influence of microvibrations on spacecraft performances p 134 N92-23825
Stretched skin concept for the entry aerodynamic decelerator system of planetary probes p 134 N92-23836
A symmetric coupling between BEM and FEM for dynamical analysis of spacecraft p 196 N92-23846
Gravity field data products from the Aristoteles mission p 224 N92-23925
Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft [AGARD-R-783] p 83 N92-23950
Computational procedures for preliminary design p 84 N92-23952
The Reentry of Salyut-7/Kosmos-1686 [ESA-SP-345] p 134 N92-23967
Spacecraft Guidance, Navigation and Control Systems [ESA-SP-323] p 135 N92-24432
The attitude and orbit control system on the Aristoteles satellite p 135 N92-24445
Trajectory optimisation and guidance strategies for reentry p 136 N92-24451
Management of navigation means failure in Hermes space vehicle p 136 N92-24467
Robust control of an aerodynamically unstable launcher with bending modes p 136 N92-24471
Modern control techniques for spacecraft AOC/GNC systems p 137 N92-24495
On the nonlinear adaptive control of a flexible spacecraft p 137 N92-24499
Aerostat for the Mars 1994/1996 mission p 285 N92-24642
The concept of a long duration stratospheric balloon p 43 N92-24645
Spacecraft Flight Dynamics [ESA-SP-326] p 122 N92-24719
Spacecraft thermal control coatings p 151 N92-24829
European industrial capabilities to provide meteorological space systems p 228 N92-25238
The heat pipe heat exchangers: Design, technology and applications p 154 N92-25666
Radars and Lidars in Earth and Planetary Sciences [ESA-SP-328] p 158 N92-25668
ASTRA: Altimetry and Sounding of Titan with a Radar on a descending craft p 285 N92-25679
Fourth European Symposium on Space Environmental Control Systems, volume 1 [ESA-SP-324-VOL-1] p 138 N92-25828
Computation of thermal radiation on spacecraft with mobile parts p 259 N92-25848
SOHO: A challenge in spacecraft thermoelastic design and verification p 139 N92-25859
Development of cryocoolers for space applications using hydrodynamic gas bearings p 154 N92-25875
Integrated heat pipe concept for Li/SOC2 cells cooling p 160 N92-26974
Effects of ultra-vacuum and space environment on contact ohmic resistance: LDEF experiment AO 138-11 p 160 N92-27118
Performances of 250 Amp-hr lithium/thionyl chloride cells p 143 N92-27148
LDEF: Dosimetric measurement results (AO 138-7 experiment) p 271 N92-27231
Spacecraft thermal control coatings: Comparison between flight results obtained on LDEF and MIR p 151 N92-27300
New results from FRECOPA analysis p 213 N92-27304
CFD Techniques for Propulsion Applications [AGARD-CP-510] p 198 N92-27450
On the computation of unsteady turbomachinery flows. Part 1: Euler equations in vibrating cascades p 198 N92-27460
Validation of a CANARI code by the computation of three dimensional turbulent flow in turbine valve p 100 N92-27462
Steady and unsteady 3D flow computation through a transonic turbine stage p 101 N92-27469
Presentation of a computational code for 3-D compressible flow in complex channels and cavities p 199 N92-27475
The coherent flamelet model for propulsion applications p 147 N92-27486
Three dimensional calculations of reactive flows within aircraft combustion chambers including some combustion models p 200 N92-27490
Special Course on Unstructured Grid Methods for Advection Dominated Flows [AGARD-R-787] p 200 N92-27671
Special Course on Skin Friction Drag Reduction [AGARD-R-786] p 44 N92-27706
Basic concepts on boundary layers p 44 N92-27707
Drag reduction: An industrial challenge p 44 N92-27708
Boundary layer transition: Prediction, application to drag reduction p 44 N92-27711
Turbulent skin-friction drag reduction by active and passive means, part 1 p 44 N92-27714
Technical evaluation report on the Flight Mechanics Panel Symposium on Flying Qualities [AGARD-AR-311] p 85 N92-27870
Air Vehicle Mission Control and Management [AGARD-CP-504] p 5 N92-27887
Transonic Unsteady Aerodynamics and Aeroelasticity [AGARD-CP-507] p 44 N92-27936
Direct coupling of fluid structure in transonic aeroelasticity p 46 N92-27954
Applications of ASICs to avionics [AGARD-AG-329] p 92 N92-28376
Steady and Transient Performance Prediction of Gas Turbine Engines [AGARD-LS-183] p 101 N92-28458
Steady and transient performance calculation method for prediction, analysis, and identification p 102 N92-28461
Aircraft ship operations [AGARD-AR-312] p 85 N92-28468
Integrated Design Analysis and Optimisation of Aircraft Structures [AGARD-LS-186] p 85 N92-28469
Structural optimization of aircraft p 86 N92-28472
Flight simulation and digital flight controls p 115 N92-28526
Interest in real-time simulations for the development terrain following function of radar systems p 158 N92-28529
Use of a research simulator for the development of new concepts of flight control p 116 N92-28543
The role of simulation for the study of APIS (piloting support by synthetic imagery) p 116 N92-28544
Construction of a numerical optimization method for the definition of hypersupported profiles [ONERA-RSF-43/1736-AY-146A] p 202 N92-28788
Feasibility study of hypersonic clinometric measurements at R3Ch [ONERA-RSF-136/1865-AY-728-] p 48 N92-28789

- Study of the loss of consciousness inflight by fighter aircraft pilots
[ONERA-RTS-11/3446-EY] p 249 N92-28844
- Development of an unsteady three-dimensional viscous-inviscid interaction numerical method for the calculation of airfoils vibration
[ONERA-RSF-7/3617-AY-022A] p 48 N92-29206
- Aerosols and polar stratospheric clouds measurements during the EASOE campaign p 229 N92-29306
- Fourth Meeting of the Space Agency Forum on the International Space Year (SAFISY-4)
[ESA-SP-1141] p 122 N92-29879
- Ageing airplane repair assessment program for Airbus A300 p 57 N92-30123
- Survey of French activities concerning structural airworthiness and aging aircraft p 57 N92-30130
- Computation of unsteady transonic flows using an implicit centered Euler solver without artificial viscosity
[ESA-TT-1235] p 49 N92-30514
- A subgrid-scale model based on the second-order velocity structure function p 203 N92-30651
- Continuous wavelet analysis of coherent structures p 203 N92-30673
- Vortex flow aerodynamics
[AGARD-AR-299] p 50 N92-30947
- Concurrent engineering p 260 N92-30952
- Flight crew integration in the maintenance chain of a commercial aircraft (A 320) p 276 N92-30957
- Astronautics 1977-1990 p 287 N92-30996
- Boundary layer structure over the ocean observed by LEANDRE 1 during a tramontane event p 243 N92-31014
- Airborne lidar and radiometric observations of PBL- and low clouds p 240 N92-31037
- Theoretical simulation of a 2 micron airborne solid state laser anemometer p 210 N92-31059
- Flat plates placed in depleted hypersonic flow
[SESSIA-430/91.960] p 50 N92-31508
- Contribution to the modelling of turbulent combustion in the case of stabilisation by flame-lock
[ESA-TT-1229] p 148 N92-31942
- Proceedings of the 53rd Symposium on Air Vehicle Mission Control and Management
[AGARD-AR-310] p 264 N92-32229
- Integrated Target Acquisition and Fire Control Systems
[AGARD-CP-500] p 92 N92-32437
- Model of Reynolds stress on nonorthogonal grid structures: Application to a staggered tube bundle
[ETN-92-91959] p 204 N92-32725
- Massively separated flow modeling. Experimental study of the fine structure of boundary layers. Study of the influence of external turbulence level
[ETN-92-92088] p 204 N92-32765
- Numerical simulation of turbulence at the back of the airplane p 51 N92-32769
- Pressure field developed by the random movement of the vortices near a wall
[ETN-92-91665] p 204 N92-32770
- Research on some centered implicit methods for calculating transonic flows by solving Navier-Stokes equations
[ONERA-RSF-24/1408-AY-150A] p 51 N92-32773
- Strong coupling between inviscid fluid and boundary layer of sharp leading edges: Two-dimensional stationary and turbulent cases for isolated profiles and guard vanes
[ONERA-RT-44/1621-RY-016-R] p 204 N92-32776
- Experimental study of the vortex system generated by a missile fuselage at incidence. Part 3: Three directional laser velocimetry measurements
[ONERA-RT-47/1147-AY-146A-P] p 52 N92-32800
- The Utilization of Advanced Composites in Military Aircraft
[AGARD-R-785] p 146 N92-33033
- Innovative constituents requirements to improve composites compressive strength p 146 N92-33043
- Evaluation of the effects of the environment on the behavior of the primary structures of composite material aircraft in service: Historic and current situation p 146 N92-33048
- Flutter models: Their design, manufacture, and ground testing p 109 N92-34164
- Unsteady wind tunnel tests p 109 N92-34166
- Space: Part of Europe's environment p 122 N92-70627
- Evaporation and energy fluxes in the atmospheric boundary layer during Lotrex p 234 A92-13336
- Requirements and possible technical solutions derived from the new airmobility concept of the German Army p 1 A92-14348
- Air transport research in Germany p 1 A92-17095
- Air transport research in Germany p 1 A92-21014
- No end to incidents in airspace? III p 53 A92-23172
- German-GUS cooperation in civil aviation p 3 A92-47592
- A large format film camera for high precision object recording p 207 A92-51630
- Space debris - A proposal for its international legal regulation p 282 A92-51870
- Observation of inverse domains in high Tc superconductors p 273 A92-52211
- Rarefied gas dynamics; Proceedings of the 17th International Symposium, Rheinisch-Westfälische Technische Hochschule Aachen, Germany, July 8-14, 1990
[ISBN 1-56081-122-6] p 274 A92-52701
- Hypersonic flow calculations around a 3D delta wing at low Knudsen numbers p 25 A92-52734
- Rarefied gas flow around a disc with different angles of attack p 25 A92-52753
- Experiments on separation at a compression corner in rarefied hypersonic flows p 25 A92-52755
- Force and heat transfer on a disc in rarefied flow p 25 A92-52764
- Monte Carlo simulation of the hypersonic mon- and diatomic gas flow past a disk at an angle of attack p 25 A92-52770
- Efficient computation of particle movement in 3-D DSMC calculations on structured body-fitted grids p 256 A92-52771
- Free molecular pressure probe measurements in the continuum, transitional and free molecular regimes of a free jet p 183 A92-52794
- Near-field expansion in thruster plumes p 141 A92-52799
- Airborne far-infrared heterodyne remote sensing of stratospheric OH - A feasibility study p 231 A92-52876
- High temperature MMCs for aero-engines - Challenge and potential p 145 A92-52982
- On missing boundary conditions with unsteady incompressible Navier-Stokes flows p 183 A92-53124
- Control models for ascent performance optimization of airbreathing launch vehicles p 124 A92-53645
- Radiometric calibration of an airborne C-band synthetic aperture radar p 62 A92-53731
- Ariane microgravity capsule - Retrievable spacecraft for research, in-orbit testing and preparing of commercial utilization p 121 A92-53774
- The Intospace Market Development Strategy and the scenario of provided microgravity, and launch systems p 279 A92-53777
- Bi-propellant thruster family for spacecraft propulsion
[AIAA PAPER 92-3860] p 141 A92-54208
- Investigation on optimizing the design process of multi-hole pressure probes for transonic flow with panel methods p 208 A92-54302
- A new optical pressure measurement system (OPMS) p 208 A92-54303
- Aerodynamic assessment of an optical pressure measurement system (OPMS) by comparison with conventional pressure measurements in a high speed wind tunnel p 208 A92-54304
- Conception of a UHB engine simulator for the essential characteristics of a true-scale engine p 112 A92-54322
- Some important factors in turbulence in flight measurement p 90 A92-54324
- Application of a wall pressure method in a wind tunnel test section with adjustable longitudinal slots p 112 A92-54336
- Spectral analysis with a LDA in high speed flow p 209 A92-54339
- Hot melt joints for carbon fibre reinforced composites p 213 A92-54870
- Asymptotic equations for the stretching of vortex filaments in a background flow field p 184 A92-54971
- Traveling magnetospheric convection twin-vortices - Observations and theory p 232 A92-55089
- A general approach to optimal real-time guidance of dynamic systems based on nonlinear programming
[AIAA PAPER 92-4378] p 260 A92-55182
- Reentry control of a low-lift maneuverable spacecraft
[AIAA PAPER 92-4455] p 124 A92-55216
- ATTAS flight test and simulation results of the advanced gust management system LARS
[AIAA PAPER 92-4343] p 106 A92-55332
- Solving the aeroassisted orbital transfer problem by using a sequential optimization approach
[AIAA PAPER 92-4646] p 124 A92-55401
- Gaseous sulfuric acid and sulfur dioxide measurements in the Arctic troposphere and lower stratosphere - Implications for hydroxyl radical abundances p 232 A92-55441
- Computer-aided discrimination of slow and fast tracer paths p 184 A92-55477
- On the effects of fluid temperature on hot wire characteristics. II - Foundations of a rational theory p 184 A92-55479
- Experiences during a 14 months overwintering with respect to potential human habitation on other planets
[IAF PAPER 92-0249] p 244 A92-55688
- Nine-degree-of-freedom simulation of rotating parachute systems p 55 A92-56155
- Repair procedures for advanced composites for helicopters p 4 A92-56277
- 'A new proposal for an old problem' - The right engine for the right helicopter p 96 A92-56281
- Integrated helmet system testing for a nightflying helicopter p 90 A92-56291
- Test and integration concept for complex helicopter avionic systems p 90 A92-56292
- Short takeoff optimization for the XV-15 tiltrotor aircraft p 74 A92-56302
- Modern helicopter technologies at MBB and the application in future programmes p 4 A92-56304
- Blade instability of horizontally stoppable rotors p 106 A92-56308
- Analysis of helicopter rotor-fuselage interference with time averaged pressure distribution p 27 A92-56331
- Current European rotorcraft research activities on development of advanced CFD methods for the design of rotor blades (BRITE/EURAM 'DACRO' project) p 27 A92-56332
- Development of a conceptual design method for rotary-wing aircraft using digital computers p 75 A92-56340
- BVI impulsive noise reduction by higher harmonic pitch control - Results of a scaled model rotor experiment in the DNW p 268 A92-56344
- Investigation of a plate-ramp-configuration by means of laser Doppler anemometry at Mach 2.95
[AIAA PAPER 92-3956] p 112 A92-56784
- Plasma thruster development program at the IRS
[IAF PAPER 92-0610] p 141 A92-57061
- Plug engine systems for future launch vehicle applications p 141 A92-57090
- Unmanned orbital servicing - From ground tests to in-orbit demonstration
[IAF PAPER 92-0780] p 122 A92-57189
- The German Hypersonics Technology Programme - Status report 1992
[IAF PAPER 92-0867] p 127 A92-57258
- Crystal growth experiments on Russian unmanned spacecraft
[IAF PAPER 92-0934] p 151 A92-57307
- Spacecraft low frequency residual acceleration
[IAF PAPER 92-0970] p 133 A92-57328
- Safety and mission capabilities of manned launch vehicles
[IAF PAPER 92-0383] p 128 A92-57370
- A systematic formulation, as an approach to air traffic
[MBB-Z-0371-91-PUB] p 62 N92-10996
- The electronic aeronautical chart for general aeronautics: A system specification
[ILR-MITT-263(1991)] p 62 N92-10997
- CO2 laser active remote sensing from 9 to 11 microns: Airborne and laboratory application p 223 N92-11535
- Procedure for determination of three-dimensional wind tunnel wall interferences and wall adaptation in compressible subsonic flow using measured wall pressures
[DLR-FB-91-09] p 113 N92-12005
- Optimality conditions for minimax tasks: An application example from communications engineering
[ETN-91-90169] p 156 N92-12156
- The stability of graphite brushes at high velocity
[ETN-91-90176] p 160 N92-12184
- Existence of three dimensional, steady, inviscid, incompressible flows with nonvanishing vorticity
[PREPRINT-1365] p 187 N92-12219
- Tool supported software development experiences from the EFA project p 256 N92-12451
- Process/object-oriented Ada software design for an experimental helicopter p 257 N92-12461
- Code generation for fast DSP-based real-time control p 257 N92-12462
- Expert system for the Tornado ground-based check-out system p 91 N92-12536
- On the simulation of compressible turbulent flows past delta wing, delta wing-body and delta wing-canard p 31 N92-13003
- On the footprints of three-dimensional separated vortex flows around blunt bodies: Attempts of defining and analyzing complex flow structures p 31 N92-13005

G

GERMANY

- Registration of aircraft in the aircraft registrar using the 'Leasing Decree' of the Federal Minister of Transport of February 12, 1991 p 279 A92-11215

- Vortex formation over a close-coupled canard-wing-body configuration in unsymmetrical flow p 31 N92-13010
On aircraft wake properties and some methods for stimulating decay and breakdown of tip vortices p 32 N92-13021
Holographic dispersive concentrators for photovoltaic power generators p 142 N92-13236
Extended mapping and characteristics techniques for inverse aerodynamic design p 76 N92-13949
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques p 33 N92-13951
DME growth elements and their use with MLS p 62 N92-14018
A Taxi And Ramp Management And Control System (TARMAC) p 113 N92-14027
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment p 91 N92-14054
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations p 213 N92-14360
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] p 219 N92-14382
Review of investigations on aeronautical fatigue in the Federal Republic of Germany p 219 N92-14397
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP p 219 N92-14420
Methodology for assessment of skin repairs on Airbus aircraft p 219 N92-14428
A concept for the revisions of structural inspection schedules p 215 N92-14431
Simulation requirements for RCS plume: Flowfield interaction modelling on a winged reentry vehicle p 34 N92-14985
Steps towards an efficient and accurate method solving the Euler equations around a re-entry configuration at super- and hypersonic speed p 34 N92-14987
Base pressure measurements on a cone at hypersonic Mach numbers: A contribution to aerothermodynamics for space vehicles p 35 N92-14992
Experimental study of hypersonic shock wave boundary layer interactions by means of infrared technique p 35 N92-14994
Short time force measurement system p 114 N92-15001
Verification and application of the NSFLEX method for hypersonic flow conditions p 36 N92-15005
Efficient solution of three-dimensional viscous hypersonic flows p 37 N92-15007
Viscous shock-layer equations for the calculation of reentry aerothermodynamics p 37 N92-15008
The IRS plasma wind tunnels for the investigation of thermal protection materials for reentry vehicles p 114 N92-15009
FALKE and COBRA technology development in aerodynamics and aerothermodynamics p 37 N92-15017
Testing high order shock-capturing schemes in 2D super- and hypersonic flows p 38 N92-15023
Computational aerothermodynamic methods for industrial applications to re-entry and hypersonic cruise problems p 188 N92-15027
Behaviour and modelling of the aerothermodynamics of ballistic entry vehicles in the high altitude flow regimes p 38 N92-15031
Applicability of bridging methods to hypersonic rarefied flow aerodynamics of reentry vehicles p 38 N92-15032
Aerothermodynamic challenges of the Saenger space-transportation system p 39 N92-15042
Project of an adaptive multi-axial autopilot with learning pilot control [ETN-92-90592] p 107 N92-15072
Lite-Sat's for specific communication tasks p 156 N92-15232
The acoustic flashlight [MBB-Z-0359-90-PUB] p 282 N92-15938
Three-dimensional computer graphics in flow visualization p 189 N92-16227
The recovering of flow features from large numerical data bases p 189 N92-16231
Visualization of stationary flows by particle traces p 189 N92-16234
Parallel and vector aspects of a multigrid Navier-Stokes solver [PB91-232868] p 260 N92-16645
Rapid repair of integrally stiffened carbon fibre composite structures by bolted aluminium elements [MBB-FE202-S-PUB-0453-A] p 145 N92-17310
Comparison of two solution methods for the numerical calculation of hypersonic flows [MBB-FE211-S-PUB-446] p 39 N92-17311
Numerical grid generation using a variational method [MBB-FE211-S-PUB-447] p 190 N92-17312
Aerodynamic development of the X-31 aircraft for the high angle of attack region [MBB-FE211-S-PUB-452] p 77 N92-17313
A short or a long cylinder: What difference does it make to the Karman vortex street? p 40 N92-17314
Investigation on the control of a Karman vortex street [MPIS-99/1990] p 40 N92-17315
Development of an electronic high speed camera system for the quantitative analysis of unsteady flows [MPIS-100/1991] p 209 N92-17344
Constraints and difficulties in implementations of RAMS assurance programmes [MBB-UK-0141-91-PUB] p 215 N92-17544
Institute for experimental fluid mechanics: Results for 1990 [IB-222-90-A-46] p 191 N92-18244
Design, analysis, and testing of integrally stiffened composite centre fuselage skin for future fighter aircraft [MBB-FE2-PUB-S-450] p 78 N92-18333
Fatigue life behaviour of composite structures p 145 N92-18577
Aircraft tracking for structural fatigue p 79 N92-18584
The Operational Loads Monitoring System, OLMS p 79 N92-18586
Tornado structural fatigue life assessment of the German Air Force p 79 N92-18592
The need for active software product assurance management for systems critical software p 257 N92-18623
System safety approach in manned Spacelab missions for control of hazards by software p 153 N92-18624
Product assurance and safety implementation on Space Shuttle payloads: An industrial perspective [MBB-UK-0143-PUB] p 216 N92-18632
A managerial approach for reliability verification of mechanical equipment p 275 N92-18634
Integration of RAMS activities during the development phase of Ariane-5 components (example: VULCAIN thrust chamber) [MBB-UK-0144-PUB] p 142 N92-18636
Collection of product assurance data and their effective utilization p 216 N92-18651
X-31 enhancement of aerodynamics for maneuvering beyond stall p 80 N92-18779
X-31: Discussion of steady state and rotary derivatives p 81 N92-18789
Transformation of flightmechanical design requirements for modern fighters into aerodynamic characteristics p 81 N92-18794
Aeroservoelastic stability of aircraft at high incidence p 108 N92-18795
The COMPAS system in the ATC environment [DLR-MITT-91-08] p 62 N92-19041
Design principles of automation aids for ATC approach control p 62 N92-19042
COMPAS system concept p 63 N92-19043
Evaluation of the COMPAS experimental system p 63 N92-19044
Experiences developed in transferring the experimental COMPAS system to an operational prototype version p 63 N92-19045
Steps toward acceptance p 63 N92-19046
Evaluation of the COMPAS operational system p 63 N92-19047
Extension of the Frankfurt COMPAS for general application p 63 N92-19048
The impact of COMPAS on the future Cooperative Air Traffic Management Concept (CATMAC) p 63 N92-19049
The role of planning systems in future air traffic management p 64 N92-19050
Simple models for the description of turbulence in the atmospheric boundary layer [DLR-FB-90-17] p 232 N92-19292
Modelling of chemical and physical effects with respect to flows around reentry bodies [MBB-FE-211/S/PUB/0465/A] p 40 N92-19296
Stochastic perturbed systems: Theory and practice of Karman vortex streets [MPIS-4/1991] p 193 N92-20180
High energy propulsion units for the year 2000 [ETN-92-90989] p 129 N92-20249
Development of a configurable infrastructure for the control of a large variety of spacecraft: The SCOS p 258 N92-20600
The integration and test of modern spacecraft control systems p 261 N92-20601
Flying an aircraft as a problem-solving process: About the Instrument-Failure-Simulator (IFS) as a test for pilot-candidates [DLR-FB-91-23] p 64 N92-20902
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91006] p 194 N92-21232
Boundary layer flow in axial compressors (theoretical part) [ETN-92-91008] p 194 N92-21234
Rigid levitation, flux pinning, thermal depinning and fluctuation in high-Tc superconductors p 273 N92-21635
Preparation of the ice certification of the Dornier 328 regional airliner by numerical simulation and by ground test p 56 N92-21693
Three-dimensional simulations of hypersonic flows [MBB-UK-0155-89-PUB] p 42 N92-21703
Enhanced numerical inviscid and viscous fluxes for cell centered finite volume schemes [MBB-FE-211/S/PUB/458/0] p 194 N92-21704
Concept and analysis of an integrated hydrojet propulsion with a rotation symmetrical boundary layer inlet [ETN-92-91161] p 213 N92-21993
Materials and Structures Research Department: Scientific report (1990) [ETN-92-90727] p 82 N92-22000
Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows [MBB-FE211-S-PUB-449] p 42 N92-22179
Problem 3: Flow over a 2-D ramp Navier-Stokes calculations p 42 N92-22180
Cases 6.1 and 6.8 double ellipsoid: Navier-Stokes calculation p 42 N92-22181
Case 7.4 delta wing: Navier-Stokes calculation p 42 N92-22182
Case 6.1 and 6.8 ellipsoid: Euler-boundary layer calculation p 42 N92-22183
First approach to an integrated fin design p 83 N92-23236
Introduction: Ocean air observation p 224 N92-23381
Recommended system concept p 224 N92-23383
Seaborn lidar system p 224 N92-23389
Passive optical and IR sensors [MBB-UH-HE512] p 224 N92-23392
Quick-look system p 224 N92-23393
Preconsiderations on aircraft integration p 224 N92-23402
Sensor compatibility/optimal sensor combinations p 224 N92-23403
National user interfaces p 224 N92-23407
Protection of spacecraft against meteoroid/orbital debris impacts p 134 N92-23786
Numerical investigation of fluid-structure-interaction problems with the finite element method p 196 N92-23844
Market directed thinking in a technological operation p 276 N92-23929
Introduction to Special Course on Engineering Methods in Aerodynamic Analysis and Design of Aircraft p 84 N92-23951
Modelling of aerodynamic forces and heat transfer for orbital decay and reentry calculations p 134 N92-23974
Prediction of solar and geomagnetic activity for ESA low-flying spacecraft p 285 N92-23975
Numerical prediction of boundary layers and transitional flows p 196 N92-24342
Subject space 2: A documentation on space research in North-Rhineland-Westphalia in the period 1985-1990 [ETN-92-91068] p 287 N92-24351
Development of a submillimeter/far infrared heterodyne spectrometer: Testing on spacecraft as a preparation for the FIRST project p 209 N92-24363
Determination of the structural weight of spacecraft p 135 N92-24387
Modeling and simulation of complex mechanical systems for space applications p 135 N92-24389
Interaction between shock wave and tubular flow p 197 N92-24392
Hypersonic configurations in slow speed flight p 43 N92-24394
Supersonic flow in compression stages and inlets p 43 N92-24395
FALKE: Winged re-entry vehicle flight control p 136 N92-24454
Spacecraft attitude control using magnetic torquers and gas jets p 137 N92-24496
Balloon-borne drop capsule MIKROBA p 152 N92-24617
A note on the interannual variability of the polar vortex in the Arctic p 233 N92-24659
Approach to the evaluation of interferences between co-located geostationary spacecraft p 137 N92-24721
Photographic observations of the co-located spacecraft at 19 deg West p 138 N92-24724
Estimation of attitude thruster activity of spacecraft on Sun acquisition mode p 138 N92-24755

- Cluster: Fuel optimum spacecraft formation control p 122 N92-24777
- Experiences in the development of rotary joints for robotic manipulators in space applications p 213 N92-25073
- The engagement of German space industry in national and European environmental space programmes p 229 N92-25242
- DLR-news: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-25413
- Flight test of avionic and air-traffic control systems [ETN-92-91063] p 65 N92-25590
- The DLR test aircraft in FZ-BS VFW614/ATTAS, Dornier DO228-101, MBB BO 105-S-3 p 84 N92-25591
- The basic measuring technical equipment of the DLR test aircraft p 92 N92-25592
- Introduction and execution of flight tests at the DLR p 85 N92-25594
- ATTAS experimental cockpit and ATMOS for flight control components and systems investigations p 65 N92-25595
- Testing of an experimental FMS p 85 N92-25596
- Testing concept of a movement area guidance p 65 N92-25597
- Ground and satellite supported flight trajectory measurement by example of the avionics flight test system AFES p 65 N92-25600
- Board-autonomous flight trajectory measurement by example of an ILS measuring system p 65 N92-25601
- Testing of an experimental photographic reconnaissance system p 209 N92-25602
- Arrangements and methods for the survey of aircraft radio components and systems p 92 N92-25603
- Two-phase thermal technology for space application: Development status p 138 N92-25834
- Application of CFD tools in space projects p 197 N92-25897
- DLR-News: Announcements of the German Research Institute for Aeronautics and Astronautics p 287 N92-26086
- Contributions to atmospheric physics in honor of Dr. Manfred Reinhardt on his 65th birthday [DLR-FB-91-30] p 233 N92-26329
- Upper/lower vortex interaction and potential vorticity inversion p 233 N92-26331
- The stability of barotropic vortices: Implications for tropical cyclone motion p 240 N92-26335
- Aircraft observation of a small-scale solitary wave near the tropopause p 234 N92-26336
- Investigation of convection over sea by aircraft observations p 225 N92-26337
- Cirrus clouds and condensation trail on 18 Oct. 1989 over the North sea (ICE '89). Determination of height and optical depth using ALEX, AVHRR and HIRS p 234 N92-26340
- Precipitation formation processes in convective and stratiform clouds as deduced by coordinated polarimetric radar and aircraft measurements p 240 N92-26342
- Remote sensing of atmosphere with aircraft borne lidar systems p 234 N92-26347
- The DLR meteorological research aircraft Falcon p 240 N92-26348
- The icing of the wing upper side and bottom side of the icing research aircraft of the DLR p 57 N92-26349
- The transpirator, an efficient and light evaporative-cooler for space technology p 154 N92-26986
- Conjugating binary systems: Advanced cooling liquids for use in spacecraft ATCS p 197 N92-27027
- The HUS solar flare and cosmic gamma ray burst detector aboard the Ulysses spacecraft [MPE-PREPRINT-175] p 283 N92-27049
- Long-term exposure of bacterial spores to space p 244 N92-27126
- Computational techniques for solving the Navier-Stokes equations p 198 N92-27451
- Computation and visualization of specific flow phenomena in turbomachinery application p 100 N92-27463
- CFD contributions during hypersonic airplane intake design p 199 N92-27472
- Application of finite element method to hypersonic nozzle flow computations p 199 N92-27479
- The 3-D Navier-Stokes flow and temperature field computation for a forced mixer nozzle p 200 N92-27482
- Flow computation in combustion chambers using zonal nonstaggered grids p 200 N92-27483
- Knowledge-based planning for controlled airspace flight operation as part of a cockpit assistant p 66 N92-27895
- On board planning of 4D-trajectories p 66 N92-27897
- Optimal guidance anticipating missile performance p 128 N92-27902
- Implementation and operational experience with a new arrival traffic management system at the Frankfurt ATC-Center p 66 N92-27905
- Comparison of Euler and full potential methods for unsteady transonic flow calculations p 45 N92-27943
- Computation of the unsteady transonic 2D cascade flow by an Euler algorithm with interactive grid generation p 45 N92-27944
- Evaluation of an unsteady implicit Euler code against two and three-dimensional standard configurations p 45 N92-27945
- Computations of unsteady flows around airfoil sections by explicit and implicit methods solving the Euler and Navier-Stokes equations p 46 N92-27948
- Computation of viscous phenomena in unsteady transonic flow p 46 N92-27949
- Computation of flutter boundaries in the time and frequency domain p 46 N92-27952
- Calculation of installation effects within performance computer programs p 102 N92-28465
- Practical architecture of design optimisation software for aircraft structures taking the MBB-Lagrange code as an example p 86 N92-28471
- Mathematical optimization: A powerful tool for aircraft design p 86 N92-28474
- Opportunities for flight simulation to improve operational effectiveness p 115 N92-28523
- Development and evaluation of an attack and maneuvering system with combat development simulators as main development tool p 116 N92-28541
- Use of a virtual cockpit for the development of a future transport aircraft p 117 N92-28547
- The role of systems simulation for the development and qualification of ATTAS p 117 N92-28548
- Calculation of support interferences on the aerodynamic coefficients for a wind tunnel calibration model [ESA-TT-1247] p 48 N92-29159
- DLR research reports and communications [ETN-92-91391] p 287 N92-29218
- Activities report of the DLR [ETN-92-91392] p 287 N92-29219
- Diode-pumped Nd:YAG lidar for airborne cloud measurements p 210 N92-29326
- Saenger: The reference concept and its technological requirements - aerothermodynamics [MBB-FE-202-S-PUB-0463-A] p 128 N92-29629
- Technology programme: Aerothermodynamics and propulsion integration. Numerical and experimental aerothermodynamics [MBB-FE-202-S-PUB-0464-A] p 48 N92-29648
- Aerothermodynamics and propulsion integration in the Saenger technology programme [MBB-FE-202-S-PUB-0469-A] p 48 N92-29649
- Concurrent engineering in design of aircraft structures [MBB-FE-2-S-PUB-472] p 87 N92-29650
- Aerothermodynamic challenges of the Saenger space-transportation system [MBB-FE-202-S-PUB-0462-A] p 129 N92-29680
- Hypersonic flow past radiation-cooled surfaces [MBB-FE-202-S-PUB-0468-A] p 49 N92-29713
- A semi empirical method for the analytical representation of stationary measured profile coefficients for applications of rotary wing aerodynamics [ETN-92-91491] p 49 N92-29741
- Sensor fault detection on board an aircraft with observer and polynomial classifier [DLR-FB-91-34] p 92 N92-29870
- Repair procedures for advanced composites for helicopters [MBB-UD-0606-91-PUB] p 5 N92-29874
- Global and high resolution radar cross section measurements and two-dimensional microwave images of a scaled aircraft model from the type Airbus A 310 [DLR-MITT-91-10] p 158 N92-29877
- Production of periodical Mach number variations in high subsonic flow in a blow down wind tunnel, and its influence on profile measurements [ETN-92-91492] p 49 N92-29889
- Experimental examination of heavy loaded axial fans with rotational symmetrical distortion of the inflow [ETN-92-91489] p 202 N92-29926
- Jet aircraft noise at high subsonic flight Mach numbers [DLR-FB-91-28] p 270 N92-29997
- Acquisition of an aerothermodynamic data base by means of a winged experimental reentry vehicle [MBB-FE202/S/PUB/461] p 5 N92-30232
- The Eurofar program: An European overview on advanced VTOL civil transportation system [MBB-UD-0611-91-PUB] p 58 N92-30418
- MBB-LAGRANGE: A general structural reliability and optimization structural system [MBB/FW321/S/PUB/467] p 220 N92-30423
- Multidisciplinary optimization of fiber composite aircraft structures [MBB/FW321/S/PUB/476] p 87 N92-30424
- Calculation of viscous hypersonic flows in chemical non-equilibrium [MBB/FE211/S/PUB/466] p 204 N92-30674
- Numerical optimization in Germany: A non-exhaustive survey on current activities with emphasis on aeronautics [MBB/FE211/S/PUB/474] p 5 N92-30675
- CFD contributions during hypersonic airplane intake design [MBB/FE213/S/PUB/459] p 50 N92-30676
- Trial of a slant visual range measuring device p 210 N92-31043
- Dense fog on the highway: Visual range monitoring in cars? p 241 N92-31106
- The icing of the elevator of the DLR icing research aircraft of Do 28 type [DLR-MITT-91-12] p 58 N92-31813
- Analysis of three icing test flights reaching the aircraft-referred icing degree of severe [ESA-TT-1254] p 58 N92-31943
- Airborne experimental FLIR program p 93 N92-32447
- Examples of advanced near-net shape manufacturing techniques for aerospace [MBB-Z-0399-91-PUB] p 154 N92-32742
- Numerical simulation of two-dimensional flows by the free-Lagrangian method [TUM-M9105] p 204 N92-32767
- New accelerated corrosion test methods [MBB-Z-0406-91-PUB] p 150 N92-32895
- Advanced Study for Active Noise Control in Aircraft (ASANCA) [AIAA PAPER 92-2092] p 270 N92-32956
- Pilots noise exposure during a Boeing 747-400 round trip: Ambient noise and acoustic-head recording and analysis of data p 270 N92-32960
- Pilot noise exposure during a Boeing 747-400 round trip: Judgement of noise and analysis in respect to hearing impairment of pilots p 271 N92-32961
- A multivariable control concept for a gas turbine engine [ETN-92-92104] p 102 N92-33645
- MBB Deutsche Aerospace financial year [ETN-92-91908] p 276 N92-33686
- Examination and mapping of forest damage using remote sensing methods [ETN-92-91913] p 225 N92-33691
- Experimental and theoretical investigations of uniformly and unequally spaced turbine cascades [ETN-92-92056] p 205 N92-33910
- Influence of the swirl producing construction in the flow and reaction field of turbulent diffusion flames [ETN-92-92103] p 205 N92-33916
- Experimental investigation of cross-flow instability in the linear and non-linear stage of the transition region [ESA-TT-1237] p 205 N92-33996
- Analytical and experimental investigation of transverse flow aerodynamic windows for high power lasers [ESA-TT-1251] p 211 N92-34152
- The field of potential vorticity during the development of a cyclone [BLL-MO-TRANS-1705(5733.360)] p 241 N92-70048
- List of reports, 1989 p 278 N92-71169
- List of reports, 1990 p 278 N92-71170
- GREECE**
- Turbine cascade calculations through a fractional step Navier-Stokes algorithm [ASME PAPER 91-GT-55] p 7 A92-15533
- 3-D loss prediction based on secondary flow and blade shear layer interaction [ASME PAPER 91-GT-59] p 7 A92-15536
- Unsteady Euler calculations in 2-D internal aerodynamics with introduced vorticity [ASME PAPER 91-GT-168] p 8 A92-15603
- Combination of different unsteady quantity measurements for gas turbine blade fault diagnosis [ASME PAPER 91-GT-201] p 214 A92-15624
- A procedure for automated gas turbine blade fault identification based on spectral pattern analysis [ASME PAPER 91-GT-259] p 214 A92-15661
- Local solution acceleration method for the Euler and Navier-Stokes equations p 168 A92-26409
- Arbitrary blade section design based on viscous considerations - Background information p 15 A92-36029
- Optimal measurement and health index selection for gas turbine performance status and fault diagnosis [ASME PAPER 91-GT-294] p 94 A92-36889
- Simulation of turbulent velocity profiles appearing on rotating and stationary parts of subsonic compressors and turbines p 175 A92-40172
- Computation of aircraft geometric height under radar surveillance p 61 A92-40239

- Upwind schemes for Navier-Stokes computations at subsonic through hypersonic speeds p 19 A92-43071
 Transonic unsteady inviscid and viscous flow's simulation around 2-D moving bodies
 [AIAA PAPER 92-2704] p 21 A92-45546
 Discrete-phase effects on the flow field of a droplet-laden swirling jet with recirculation - A numerical study
 p 178 A92-45603
 Unsteady Euler calculations in 3D internal aerodynamics p 199 A92-27470
 Three dimensional flow in sharp bends p 200 A92-27481

H

HUNGARY

- Passive microwave remote sensing of soil moisture from aircraft in Hungary p 221 A92-27231
 An attempt to unify space terminology - The Multilingual Terminology Data Base
 [IAF PAPER 92-0343] p 277 A92-55758
 Some new definitions for the Multilingual Terminology Data Base
 [IAF PAPER 92-0359] p 277 A92-55766

I

ITALY

- In-orbit experiment of object capture technology
 [IAF PAPER 91-002] p 251 A92-12427
 Experimental testing of Taylor's hypothesis by L.D.A. in highly turbulent flow p 162 A92-13671
 The Eurofar vehicle overview p 67 A92-14416
 A prediction method to evaluate the acoustic response of spacecraft external panels - An application to the Italsat structure development
 [IAF PAPER 91-288] p 130 A92-14714
 Transonic and supersonic inviscid computations in cascades using adaptive unstructured meshes
 [ASME PAPER 91-GT-312] p 8 A92-15689
 Transonic cascade flow prediction using the Navier-Stokes equations p 8 A92-15690
 Aircraft navigation using Global Positioning System improved with geostationary satellites p 59 A92-16934
 Application of aircraft multispectral scanner data to algae mapping over the Venice Lagoon p 221 A92-17104
 Vortices and defect statistics in two-dimensional optical chaos p 272 A92-17891
 The enhancement of the Italsat spacecraft - A step forward the communication satellites
 [IAF PAPER 91-473] p 131 A92-18494
 Italsat spacecraft multibeam payload antenna closed loop line pointing system
 [IAF PAPER 91-509] p 129 A92-18519
 Dynamics of a tethered satellite subjected to aerodynamic forces p 123 A92-18606
 A two-step Godunov-type scheme for the Euler equations p 261 A92-19124
 High temperature low cycle fatigue of single crystal nickel base superalloys p 148 A92-19796
 Incompressible steady aerodynamics using a standard finite element code p 11 A92-20218
 Nonequilibrium hypersonic inviscid steady flows p 11 A92-20737
 A boundary integral formulation for the kinetic field in aerodynamics. I - Mathematical analysis p 11 A92-21504
 Gust effects on a flexible aircraft p 68 A92-22474
 A boundary element method for the potential, compressible aerodynamics of bodies in arbitrary motion p 12 A92-25098
 A constraint satisfaction approach to operative management of aircraft routing p 54 A92-25181
 Vortices on accretion disks p 284 A92-27396
 A boundary integral formulation for the kinetic field in aerodynamics. II - Applications to unsteady 2D flows p 14 A92-28005
 Navier-Stokes solution of transonic cascade flows using nonperiodic C-type grids p 14 A92-28523
 Numerical simulation of tripolar vortices in 2D flow p 169 A92-28990
 Computer simulation of absolute and contrast infrared signatures from missile noses p 272 A92-29392
 Simulation of hypersonic flows on unstructured grids p 15 A92-31496
 Columbus user support organization concept in Italy p 119 A92-32465
 Multisensor, multifrequency, multitemporal aircraft microwave measurements over agricultural fields p 222 A92-35302
 Innovation in the laser warning sensor field p 89 A92-35742

- Test Engineering Language for Avionic Systems p 89 A92-35763
 Transmission vibration monitoring - A single board computer architecture p 89 A92-35765
 A simple point vortex model for two-dimensional decaying turbulence p 171 A92-36192
 Reynolds stress distribution downstream of a turbine cascade p 17 A92-38861
 An algebraic property of the turbulent stress and its possible use in subgrid modeling p 174 A92-40129
 A model for bursting of near wall vortical structures in boundary layers p 174 A92-40156
 Numerical predictions of transonic viscous flows around aerofoils through an Euler/boundary layer interaction method p 18 A92-40600
 Turbulence - The filtering approach p 175 A92-41656
 Analysis of wind tunnel dispersion data over two-dimensional obstacles p 228 A92-42093
 Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings p 144 A92-42141
 An experimental study on laser drilling and cutting of composite materials for the aerospace industry using excimer and CO2 sources p 212 A92-42142
 Metal matrix composite fabrication processes for high performance aerospace structures p 212 A92-42145
 Radiation and coupling between antennas mounted on a complex metallic structure p 155 A92-42315
 Equilibrium configurations in a tethered atmospheric mission p 124 A92-43391
 Numerical computations of solid-propellant nonsteady burning in open or confined volumes p 151 A92-43467
 An unfactored implicit scheme for 3D inviscid transonic flows
 [AIAA PAPER 92-2668] p 20 A92-45523
 Experimental investigation of vortex dynamics on delta wings
 [AIAA PAPER 92-2731] p 21 A92-45565
 Viscous high-speed flow computations by adaptive mesh embedding techniques p 21 A92-45839
 LEOSTAR - A small spacecraft for LEO communications missions p 120 A92-46468
 Hang-glider response to atmospheric inputs p 104 A92-46765
 Viscous eddies over a grooved surface computed by a Gaussian-integration Galerkin boundary-element method p 179 A92-46918
 A new integral equation for potential compressible aerodynamics of rotors in forward flight p 22 A92-46958
 An adaptive solution to parabolic problems defined on 3D multiconnected domains with automatic approximation of the boundaries p 262 A92-47047
 An unstructured mesh generation algorithm for three-dimensional aeronautical configurations p 262 A92-47053
 Multigrid grid generation in scalar and parallel environments p 256 A92-47084
 Numerical computations of transonic flows through cascades
 [AIAA PAPER 92-3041] p 24 A92-48702
 Expert systems for the trouble-shooting and the diagnostics of engines p 260 A92-48910
 Prediction of gas turbine combustor flow by a finite element code p 181 A92-49016
 The numerical simulation of the main fuel control unit of gas turbine engines
 [AIAA PAPER 92-3760] p 96 A92-49115
 From vortex layers to vortex sheets p 181 A92-50108
 Blood lactate during leg exercise in microgravity p 247 A92-50162
 Robust flight control systems - A parameter space design p 106 A92-50503
 Optimal finite-thrust spacecraft trajectories
 [AIAA PAPER 92-4510] p 124 A92-52080
 Amplification and meridional confinement of stationary and quasi-stationary eddies in a two-layer model p 239 A92-52594
 The Harold Grad Lecture - Mathematics and the Boltzmann equation p 274 A92-52702
 Shock wave propagation in a random (turbulent) rarefied flow p 182 A92-52724
 Fluid dynamic forces on tethered satellite systems p 124 A92-52738
 Shock-wave onset with chemical dissociation by the discrete Boltzmann equation p 182 A92-52785
 Insight into singular vortex flows p 183 A92-53052
 The use of conservative coordinates for reconstruction techniques and for the development of a two-dimensional transport model p 239 A92-53349

- Space activities in Italy p 121 A92-53457
 Detecting 3-D, turbulent separation regions using unsteady computerized thermographic technique p 26 A92-54308
 A quasi adaptive magnetic damping strategy for gravity gradient stabilized spacecraft
 [IAF PAPER 92-0031] p 132 A92-55527
 An economic benefit deriving from space activities - Integration between science institutions and industry
 [IAF PAPER 92-0177] p 279 A92-55635
 Communicate space: A comparison of two case histories - Europe and USA p 121 A92-55827
 Current European research activities in helicopter interactional aerodynamics p 75 A92-56330
 The achievement of aerodynamic goals on the EH101 project through the 'single site' concept p 75 A92-56342
 Correlation of flight, tunnel and prediction data on a helicopter main rotor p 75 A92-56350
 Numerical simulation of unsteady rotor wakes p 27 A92-56352
 An overview of the planned aerospace test facilities at Capua, Italy
 [AIAA PAPER 92-3944] p 112 A92-56773
 CARINA - A space vehicle with re-entry capabilities for microgravity experiments
 [IAF PAPER 92-0816] p 133 A92-57214
 Effects of spectrum variations on fatigue crack growth p 219 A92-57399
 Vortical flow simulation by using structured and unstructured grids p 30 A92-12999
 Numerical simulation of vortex flows past impulsively started wings p 33 A92-13028
 Research on inverse methods and optimization in Italy p 97 A92-13956
 A boundary integral approach in primitive variables for free surface flows p 187 A92-14304
 Aerothermodynamic development of the CARINA re-entry vehicle: CFD analyses and experimental tests p 133 A92-14980
 Numerical solution of discontinuity dynamics: Two dimensional supersonic flows p 36 A92-14997
 High enthalpy nozzle flows p 36 A92-15000
 Infrared measurements of aerodynamic heating in hypersonic wind tunnel p 114 A92-15002
 Aspects of non-equilibrium in arc-heated wind-tunnel simulation p 114 A92-15012
 Linear acoustics in gas mixtures with rate processes p 269 A92-15013
 Influence of chemical modelling on hypersonic flow p 37 A92-15015
 FLOVIS (FLOW VISualizer) user manual, release 2.6, September 1990 p 190 A92-16238
 Proposal for the new fatigue management system for the AMX p 78 A92-18580
 The G-222 aircraft individual tracking programme p 78 A92-18582
 A product assurance engineering concept for complex space systems p 216 A92-18645
 RAMREQ: A computerized tool for the definition of RAM (Reliability, Availability, Maintainability) requirements of complex systems p 258 A92-18647
 Prediction of aerodynamic phenomena limiting aircraft manoeuvrability p 80 A92-18781
 Parametric effects of some aircraft components on high-alpha aerodynamic characteristics p 80 A92-18782
 Parametric bicubic spline and CAD tools for complex targets shape modelling in physical optics radar cross section prediction p 157 A92-19151
 Use of target spectrum for detection enhancement and identification p 157 A92-19155
 Software management strategies and practices for space systems development p 258 A92-20610
 Standards and S/W development environments: the point of view of a S/W engineering company involved in several space programs p 64 A92-20611
 EH 101 ship interface trials: Flight test programme and preliminary results p 82 A92-21964
 Limitations on helicopter operations in the aeronaval environment p 82 A92-21973
 Electrostatic drift vortices in a hot rotating strongly magnetized electron-positron pulsar plasma
 [DE92-614464] p 284 A92-22653
 GPS differential navigation techniques for Carina reentry and spacecraft rendezvous operations p 135 A92-24443
 Full MACS controller-based self test module for spacecraft units and related testing facilities p 136 A92-24474
 A combined cabin/avionics air loop design for the Space Station logistic module p 253 A92-25841
 A systematic approach to thermal balance test evaluation and thermal mathematical model correlation for spacecraft thermal design p 139 A92-25881

- Multi-cultural components and keys for European worldwide space programs p 122 N92-27008
- Moon base habitability aspects p 254 N92-27026
- Time-marching methods for secondary flow analysis in curved ducts p 198 N92-27454
- Nonequilibrium 3D flows of air through inlets p 200 N92-27487
- A boundary integral formulation for unsteady transonic potential flows p 45 N92-27942
- AM-X flight simulator from engineering tool to training device p 116 N92-28536
- A dynamic subgrid-scale eddy viscosity model p 203 N92-30649
- Issues for the integration of satellite and terrestrial cellular networks for mobile communications p 159 N92-30941
- Titan's atmosphere structure from Huygen's-ASI measurements p 285 N92-32398
- Active vibrations and noise control for turboprop application research program activities p 271 N92-32962
- CFRP stiffened panels under compression p 146 N92-33044
- Environmental resistance of amorphous bonded thermoplastic joints p 146 N92-33053
- Viscous and Joule heating effects on MHD free convection flow with variable plate temperature [DE91-633612] p 273 N92-70166

N

NETHERLANDS

- Aerospace Arall - A challenge for the aircraft designer p 143 A92-10232
- A micrometeorological investigation of surface exchange parameters over heathland p 234 A92-11268
- Interaction between moving flux lines and a two-dimensional electron gas p 273 A92-11897
- The hydrodynamics of aspherical planetary nebulae. I - Analytic evaluation of hydrodynamic difference schemes p 285 A92-14171
- Modelling and identification of flexible spacecraft p 131 A92-15409
- Spurious, zeroth-order entropy generation along a kinked wall p 162 A92-15822
- Results of a test program for the use of differential GPS for approach guidance p 59 A92-16969
- The effects of surface inhomogeneities on the surface fluxes and on the development of the Planetary Boundary Layer p 235 A92-17730
- Inviscid drag prediction for transonic transport wings using a full-potential method p 10 A92-20212
- High performance capillary electrophoresis in microgravity environment p 206 A92-20996
- A deep convective cloud model with explicit microphysics including the ice phase p 236 A92-22994
- Quantitative estimation of secondary surveillance radar information p 59 A92-24943
- Elements of airplane performance [ISBN 90-6275-608-5] p 68 A92-26550
- USO concept in the member states - The Netherlands p 120 A92-32467
- Eurocontrol - UK detention rights p 280 A92-33048
- An aircraft manufacturer's perspective p 2 A92-33430
- First results from the Netherlands SAR testbed 'PHARS' p 221 A92-34903
- Detection of mesoscale ocean currents from Geosat altimeter data p 242 A92-34949
- Selected pitfalls and booby-traps in aircraft finance p 280 A92-35587
- Tax aspects of aircraft leasing in the Netherlands p 280 A92-35588
- Conflict of laws in the air - Some legal issues of international aircraft financing and leasing p 280 A92-35591
- Dutch security rights in aircraft and engines p 280 A92-35594
- The role of the notary under the laws of the Netherlands - With respect to the transfer of title and encumbrance of registered aircraft p 280 A92-35595
- LAH main rotor model test at the DNW p 70 A92-35771
- Approach flight trials in the Netherlands for the Navstar GPS Joint Program Office International Test Program p 60 A92-35928
- Fokker 50 flameouts in icing conditions p 71 A92-35940
- An information system for the numerical simulation of 3D Euler flows around aircraft p 16 A92-37554
- Marangoni convection in V-shaped containers p 172 A92-37932
- A note on the Kutta condition in Glauert's solution of the thin aerofoil problem p 16 A92-37933
- Playing with nonuniform grids p 172 A92-37936
- Non-destructive inspection of carbon fibre-reinforced plastics using eddy current methods p 214 A92-38088
- NATO CCMS aircraft noise study on receiver technology p 226 A92-39050
- Aircraft noise - The calculation of the noise exposure by aircraft in the Netherlands p 227 A92-39054
- Panel method control in 3-D hyperbolic grid generation p 17 A92-39940
- Large-eddy simulation of the convective boundary layer - A comparison of four computer codes p 173 A92-40054
- The evolution from bonded F27 aircraft to Arall structures p 3 A92-41177
- Joint Aviation Authorities: Development of an international standard for safety regulation - The first steps are being taken by the JAA p 281 A92-43548
- CAAC Guangzhou hi-jacking - Insurance issues p 281 A92-43549
- Heart rate variability as an index for pilot workload p 246 A92-45012
- Numerical investigation into high-angle-of-attack leading-edge vortex flow [AIAA PAPER 92-2600] p 20 A92-45477
- The design of a system of codes for industrial calculations of flows around aircraft and other complex aerodynamic configurations [AIAA PAPER 92-2619] p 256 A92-45492
- Interactions of an elastic solid with a viscous fluid - Eigenmode analysis p 178 A92-45704
- New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations p 23 A92-47079
- The sensitivity of regional transpiration to land-surface characteristics - Significance of feedback p 237 A92-47345
- Interpretation of field measurements made with a portable albedometer p 207 A92-49773
- Terminal area traffic management p 61 A92-50122
- Local error growth in a barotropic model p 239 A92-52941
- A simulator evaluation of various manual control concepts for fly-by-wire transport aircraft [AIAA PAPER 92-4328] p 106 A92-55172
- Understanding and development of a prediction method of transonic limit cycle oscillation characteristics of fighter aircraft [AIAA PAPER 92-4501] p 27 A92-55369
- Real-time helicopter simulation using the blade element method p 264 A92-56278
- Application of electronically scanned pressure measurement system for engine simulation tests in the German-Dutch Wind Tunnel [AIAA PAPER 92-4003] p 209 A92-56826
- Comparison of in situ, aircraft- and satellite-derived surface reflectances in Flevoland (Netherlands) p 223 N92-11404
- On the limitations of Froude's actuator disc concept [ETN-91-90136] p 29 N92-11973
- A knowledge-based assistant for diagnosis in aircraft maintenance p 5 N92-12538
- Reasoning with uncertain and incomplete information in aerospace applications p 261 N92-12544
- Modeling and numerical simulation of vortex flow in aerodynamics [AD-B163670L] p 30 N92-12997
- Analysis of results of an Euler-equation method applied to leading-edge vortex flow p 30 N92-13000
- Experimental and numerical investigation of the vortex flow over a delta wing at transonic speed p 30 N92-13001
- An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds p 31 N92-13011
- Power system performance prediction for the Hipparcos spacecraft p 141 N92-13155
- ESA power standard p 141 N92-13174
- Protection concepts used in spacecraft power systems p 142 N92-13176
- Review of aerodynamic design in the Netherlands p 76 N92-13929
- LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] p 33 N92-14004
- Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] p 77 N92-14045
- A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] p 187 N92-14321
- Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] p 187 N92-14325
- Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] p 188 N92-14326
- Software product assurance requirements for ESA space systems [ESA-PSS-01-21-ISSUE-2] p 257 N92-14631
- Aerothermodynamic challenges for ESA programmes p 34 N92-14974
- Fast finite element solvers for reentry flows p 35 N92-14988
- Multi-dimensional upwind schemes, multigrid and defect correction for accurate and efficient Euler flow computations p 35 N92-14989
- SIMOUN and Scirocco wind tunnel nozzle viscous flow study p 113 N92-14999
- Equilibrium solution of the Euler and Navier-Stokes equations around a double ellipsoidal shape with mono- and multi-blocks including real gas effects, part 1 p 189 N92-15030
- Parallelization of a Direct Simulation Monte Carlo (DSMC) code for fluid dynamics p 189 N92-15033
- Grid impact on 3D hypersonic flows p 39 N92-15041
- Monitoring load experience of individual aircraft [NLR-TP-90084-U] p 77 N92-15065
- Development environment for digital manipulator simulators [PB91-222190] p 213 N92-16313
- A diffraction limited nitrogen laser for detector calibration in high energy physics [ETN-92-90567] p 211 N92-17434
- CAR 88: A method to calculate subsonic and supersonic, steady and unsteady, potential flow about complex configurations [NLR-TR-88154-U] p 191 N92-18221
- VISION: A Viscous-Inviscid Strong-Interaction Analysis System [NLR-TR-88081-U] p 192 N92-18323
- Model incidence measurement using SAAB ELOPOPOS system [NLR-TP-89182-U] p 115 N92-18416
- A novel route to blends of polystyrene and poly(2,6-dimethyl-1,4-phenylene ether): Synthesis, properties, and applications [ETN-92-90578] p 151 N92-18479
- Load monitoring of F-16 A/B aircraft of the RNLAF with a smart electronic device p 78 N92-18583
- Reliability modeling for non-electronic systems p 216 N92-18633
- Safety risk management for ESA space systems p 153 N92-18635
- Why quantify risk? p 153 N92-18637
- Reliability, availability, maintainability, and safety p 216 N92-18639
- Specifying PA/safety design to requirements for the Columbus project and general conclusions p 153 N92-18649
- An evaluation of payload safety requirements for ESA manned spacecraft p 153 N92-18655
- Quality assurance requirements for ESA space systems [ESA-PSS-01-20-ISSUE-2] p 216 N92-19108
- Estimating the probability of vertical overlap from the paired aircraft data obtained in the European vertical data collection using the program DGLDIF [NLR-TR-88108-U] p 64 N92-19491
- Inviscid drag prediction for transonic transport wings using a full-potential method [NLR-TP-89365-U] p 41 N92-20473
- Investigation of a semi-empirical method to predict limit cycle oscillations of modern fighter aircraft [NLR-TP-90087-U] p 108 N92-20475
- Numerical simulation of vortical flow over a delta wing at subsonic and transonic speeds [NLR-TP-90029-U] p 41 N92-20498
- The effect of hoar-frosted wings on the Fokker 50 take-off characteristics p 56 N92-21692
- Introduction of the solid fuel combustion chamber project p 142 N92-22269
- The COPPEF-model for solid fuel combustion chamber performance prediction p 142 N92-22270
- Fuel pyrolysis in solid fuel combustion chambers p 142 N92-22271
- Spin-offs of the solid fuel combustion chamber project p 143 N92-22275
- Control of blood pressure in humans under microgravity p 248 N92-23071
- Improved shock-capturing of Jameson's scheme for the Euler equations [PB92-148758] p 196 N92-23251
- Panel methods for aerodynamic analysis and design p 84 N92-23955
- Domain modeling and grid generation for multi-block structured grids with application to aerodynamic and hydrodynamic configurations p 259 N92-24411

- Object oriented hardware simulation of spacecraft control algorithms p 259 N92-24487
Control strategies for space systems p 137 N92-24494
- Towards GLARE: The development of a fatigue insensitive and damage tolerant aircraft material [ETN-92-91301] p 84 N92-24966
Delfi: Design, development, and applicability of expert systems shells [ISBN-90-6275-734-0] p 259 N92-25306
Vortex dynamics in artificially fabricated superconducting networks [ETN-92-91296] p 160 N92-25307
Set-up and alignment aspects of a CO₂-laser radar for applications in the field [FEL-91-A162] p 158 N92-25378
ESA standardisation process through the example of manned spacecraft atmospheres p 253 N92-25842
An overview of ESA cryocooler activities p 154 N92-25850
- Winged launcher thermal design aspects p 127 N92-27013
- NLR inviscid transonic unsteady loads prediction methods in aeroelasticity p 45 N92-27947
Development of a method to predict transonic limit cycle oscillation characteristics of fighter aircraft p 108 N92-27958
- Aircraft simulation and pilot proficiency: From surrogate flying towards effective training p 115 N92-28532
G-tolerance and spatial disorientation: Can simulation help us? p 248 N92-28534
The basic research simulator programme and the industrial and aerospace community: Opportunities for cooperative research [LR-662] p 117 N92-28579
Inverse control problems: Mathematical preliminaries, system theoretical approaches, and their applications to aircraft dynamics [LR-665] p 261 N92-28581
Improvement of separations of practice bombs from a multiple bomb adapter [NLR-TP-90307-U] p 86 N92-28634
Hyperbolic grid generation with BEM source terms [NLR-TP-90334-U] p 264 N92-28635
Spacecraft sustained load fracture control [NLR-TP-89163-U] p 220 N92-28643
Quasi-recursive dynamics equations for spacecraft-based flexible robotic manipulators [NLR-TP-90028-U] p 261 N92-28648
The use of load enhancement factors in the certification of composite aircraft structures [NLR-TP-90068-U] p 86 N92-28649
Correlation, error-localisation, and updating of the second problem defined in GARTEUR AG11 [NLR-TP-90070-U] p 220 N92-28650
Modifications and results of flight tests of a practice bomb adapter [NLR-TP-90108-U] p 87 N92-28651
Some longitudinal handling qualities design guidelines for active control technology transport aircraft [NLR-TP-90129-U] p 109 N92-28652
Response of helicopters to gusts [NLR-TP-90159-U] p 109 N92-28653
Potential applications of laser Doppler anemometry for in-flight measurements [NLR-TP-90163-U] p 92 N92-28654
Application of knowledge-based systems for diagnosis of aircraft systems [NLR-TP-90192-U] p 57 N92-28655
Analysis of results of an Euler-equation method applied to leading-edge vortex flow [NLR-TP-90368-U] p 47 N92-28657
Comparison of LDA and LTA applications for propeller tests in wind tunnels [NLR-MP-88031-U] p 47 N92-28658
Calculation of unsteady subsonic and supersonic flow about oscillating wings and bodies by new panel methods [NLR-TP-89119-U] p 47 N92-28659
Constrained spanload optimization for minimum drag of multi-lifting-surface configurations [NLR-TP-90126-U] p 47 N92-28660
The windtunnel as a tool for laminar flow research [NLR-TP-90145-U] p 117 N92-28661
LAH-main rotor model test at the DNW [NLR-TP-90305-U] p 87 N92-28687
Atmospheric turbulence spectra and correlation functions [NLR-TP-89217-U] p 234 N92-28689
Development and validation of a characteristic boundary condition for a cell-centered Euler method [NLR-TP-90144-U] p 47 N92-28692
Turbulence modeling: Survey of activities in Belgium and the Netherlands, and appraisal of the status and a view on the prospects [NLR-TP-90184-U] p 201 N92-28694
- Wave drag determination in the transonic full-potential flow code MATRICS [NLR-TP-90062-U] p 47 N92-28709
Boundary conditions for Euler equations at internal block faces of multi-block domains using local grid refinement [NLR-TP-90134-U] p 202 N92-28712
Crack resistance, fracture toughness and instability in damage tolerant Al-Li alloys [NLR-TP-90172-U] p 220 N92-28850
NARSIM: A real-time simulator for air traffic control research [NLR-TP-90147-U] p 117 N92-29204
The main lines of the research programs remote sensing: Climate and environment [BCRS-91-25] p 230 N92-29499
Short cracks and durability analysis of the Fokker 100 wing/fuselage structure [NLR-TP-90336-U] p 220 N92-29603
Hyperbolic grid generation control by panel methods [NLR-TP-91061-U] p 264 N92-29604
European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. Part 1: Overview of organisation, techniques employed, and conclusions [NLR-TP-91062-U-PT-1] p 66 N92-29605
Application of VME-technology on an airborne data link processor unit [NLR-MP-88040-U] p 66 N92-29615
Results of a flight simulator experiment to establish handling quality guidelines for the design of future transport aircraft [NLR-MP-88044-U] p 87 N92-29616
Activities report of the Netherlands Remote Sensing Board (with abridged version) [ETN-92-91352] p 225 N92-29688
On the optimization of windshear warning and guidance systems [NLR-TP-90196-U] p 57 N92-29703
CAESAR: A CCD airborne experimental scanner for applications in remote sensing radiometric and geometric calibration [NLR-TP-89103-U] p 225 N92-29707
Maintainability requirements for ESA space systems [ESA-PSS-01-50-ISSUE-1] p 217 N92-29878
Evaluation of measured-boundary-condition methods for 3D subsonic wall interference [NLR-TR-88072-U] p 49 N92-29884
A finite volume approach to large eddy simulation of compressible, homogeneous, isotropic, decaying turbulence [MEMO-1009] p 202 N92-29972
Monopolar vortices as relative equilibria and their dissipative decay [MEMO-1015] p 202 N92-29977
Ageing aircraft research in the Netherlands p 57 N92-30129
Comparison of in situ, aircraft- and satellite derived surface reflectances in Flevoland (Netherlands). A validation experiment [BCRS-91-28] p 225 N92-30230
Global existence for a semilinear elliptic-parabolic PDE system [REPT-91-70] p 203 N92-30372
Low-velocity impact loading on fibre reinforced aluminum laminates (ARALL) and other aircraft sheet materials [ETN-92-91613] p 146 N92-30414
Flow of fresh and salt water in an aquifer with injection from the top [REPT-91-68] p 203 N92-30453
A multigrid method for a discretization of the incompressible Navier-Stokes equations in general coordinates [REPT-91-73] p 203 N92-30454
Examination of aircraft warning and caution lights after shock testing [NLR-TP-89284-U] p 58 N92-30474
Modeling and numerical simulation of vortex flow in aerodynamics [NLR-TP-91154-U] p 51 N92-32673
New concepts for multi-block grid generation for flow domains around complex aerodynamic configurations [NLR-TP-91046-U] p 51 N92-32730
An experimental study of the flow over a sharp-edged delta wing at subsonic and transonic speeds [NLR-TP-91117-U] p 51 N92-32732
Integration of wall interference assessment and wall adaptation [NLR-TP-91119-U] p 118 N92-32734
NLR investigations of flutter behaviour of fighter aircraft with external stores [NLR-TP-91134-U] p 109 N92-32750
Development of new flight procedures for the Microwave Landing System (MLS) [NLR-TP-91156-U] p 66 N92-32830
- Investigations preparatory to the Wet Satellite Model Experiment [NLR-TP-91219-U] p 139 N92-32834
CFD efforts in the Netherlands [NLR-TP-91250-U] p 205 N92-32835
Global/local interlaminar stress analysis of a grid-stiffened composite panel [NASA-CR-190822] p 221 N92-33139
Activities report of the National Aerospace Laboratory [ETN-92-92053] p 288 N92-33694
Radiation exposure of civil air carrier crewmembers [NLRGC/B-1-4/91] p 249 N92-33908
SCOLE dynamic analysis and frequency response using DISTEL software p 139 N92-70065
SAMID, an interactive system for aircraft drag minimization studies: Mathematical models and methods [PB91-219444] p 52 N92-70249
Damage tolerance and durability evaluation of aluminum-lithium alloys [PB91-219477] p 150 N92-70307
The 3-D Euler flows around modern airplanes [PB92-138759] p 52 N92-70540
Computation of unsteady turbulent boundary layer effects on unsteady flow about airfoils [PB92-138569] p 206 N92-70561
Selection of a laser anemometer technique for propeller tests in wind tunnels [PB92-138510] p 118 N92-70563
PROCRU simulation results compared with Metro 2 in-flight ILS approach data [PB92-138502] p 67 N92-70564
Correction for wall interference in a solid-wall wind tunnel using sparse measured boundary conditions [PB92-138577] p 118 N92-70574
Definition of P.S.D.-design loads for nonlinear aircraft [PB92-138619] p 88 N92-70575
System for transonic wing design with geometric constraints based on an inverse method [PB92-138692] p 53 N92-70576
Aspects of the application of a Euler-equation method to the simulation of leading-edge vortex flow [PB92-138718] p 53 N92-70577
Investigation of the low speed flow about a straked delta wing oscillating in pitch. Part 1: Windtunnel, model, and test program [PB92-138676] p 53 N92-70590
Review of aeronautical fatigue investigations in the Netherlands during the period March 1987 - March 1989 [PB92-138650] p 88 N92-70591
LARVE: A hypersonic flight test facility launched by Ariane 4 [PB92-138726] p 118 N92-70983
- ### NORWAY
- Spinal X-ray screening of high performance fighter pilots p 245 A92-15959
Non-invasive detection of silent myocardial ischemia - A Bayesian approach p 245 A92-16405
Calculation of fluid flows with staggered and nonstaggered curvilinear nonorthogonal grids. I - The theory. II - A comparison p 165 A92-21703
Velocity correlation in isotropic turbulence according to a modified Obukhov theory p 169 A92-28950
A most beautiful polar low - A case study of a polar low development in the Bear Island region p 237 A92-32487
Characterization of air-ice-ocean interactive processes in the MIZ based on SAR derived ice edge configurations p 242 A92-34943
Simulations of SAR imaging of ship wakes, comparing different wind growth rate models p 242 A92-35025
A structured tri-tree search method for generation of optimal unstructured finite element grids in two and three dimensions p 172 A92-37388
Computation of aircraft noise exposure using digitized topography data p 227 A92-39058
Advanced method for single event aircraft noise analysis p 266 A92-39060
Charged dust in the earth's mesopause - Effects on radar backscatter p 231 A92-41800
The Norwegian space programme p 121 A92-53453
Nonparallel-flow stability of an axisymmetric buoyant plume in a coflowing uniform stream p 183 A92-54963
Spin-up in a semicircular cylinder p 184 A92-56123
An ILU preconditioner with coupled node fill-in for iterative solution of the mixed finite element formulation of the 2D and 3D Navier-Stokes equations p 184 A92-56124
SAR imaging of vortex ship wakes. Volume 3: An overview of pre-ERS-1 observations and models [FFI-91/7007-VOL-3] p 156 N92-12157
Ocean/bottom acoustic interaction with arbitrary bottom profile [FFI-91/7009] p 242 N92-12386

POLAND

- Aviation psychology in the operational setting p 250 N92-13550
- Domestic problems and aviator family support p 251 N92-13555
- A PC-based inverse design method for radial and mixed flow turbomachinery p 97 N92-13943
- Probabilistic design and fatigue management based on probabilistic fatigue models with reliability updating p 78 N92-18574
- Space technology and industries in Norway [NSC-REPT(91)-8] p 153 N92-19521
- The Norwegian sounding rocket and balloon programme p 122 N92-24594
- The Norwegian upper atmosphere programme in Svalbard (Norway) p 233 N92-26295

P

POLAND

- Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 161 A92-10654
- Numerical studies of Rayleigh-Taylor instability by the vortex method p 161 A92-10658
- Polish radar technology. II - Adaptive radar AVIA CM p 155 A92-12290
- Polish radar technology. III - Weather channel for primary surveillance radar p 155 A92-12291
- Polish radar technology. V - Adaptive MTI filters for uniform and staggered sampling p 155 A92-12293
- Acoustic isolation of layers p 265 A92-12345
- Experimental determination of the center of mass, the principal central axes of inertia and moments of inertia p 217 A92-12346
- Automation of the measurement process in the N2 wind tunnel with the SPITA N-3 system p 110 A92-12347
- Blade defect force investigation in a compressor cascade p 6 A92-13233
- Estimation of the size of separation zone in a turbine stage under small load p 6 A92-13235
- Corrosion damage and regeneration of aluminide coatings on aircraft turbine blades p 148 A92-15244
- Error analysis of the COSPAS SARFAT system p 129 A92-21288
- A new thermometric instrument for airborne measurements in clouds p 88 A92-24918
- A discrete dynamic model of rotating shell-plate-disc structures p 218 A92-27150
- The effect of air-compressor adjustment by means of air-bleed on the reserve of its stable operation p 94 A92-29973
- General model of isolated helicopter blade for stability investigation p 71 A92-35774
- Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989, Selected Papers p 176 A92-42529
- Differential forms and fluid dynamics p 176 A92-42535
- A method for solving the 2-dimensional potential flow around thin curved profiles p 176 A92-43068
- Pragmatic simulation, basics and techniques p 251 A92-45030
- Selected models of aircraft navigation space p 61 A92-45373
- Two-point optimization of complete three-dimensional airplane configuration [AIAA PAPER 92-2618] p 73 A92-45491
- Mathematical modeling of the flight of passenger aircraft in the case of engine failure p 105 A92-47777
- Calculation of the aerodynamic derivatives of aircraft in the supersonic region using the Mach box method p 105 A92-47779
- Total losses in turbulent flows inside conical diffusers p 23 A92-47782
- Modeling of the control systems of rotary wing aircraft (Review) p 105 A92-47783
- Mathematical modeling of the effect of windshear on the dynamics of a landing aircraft p 105 A92-47784
- Aircraft stabilization at large angles of attack p 105 A92-47785
- Concept of a one-dimensional model of the dynamic behavior of a gas turbine p 96 A92-47791
- Simulation of helicopter see-saw rotor motion p 74 A92-56287
- Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization p 76 N92-13948
- The CSMA/CD local area network for hospital services p 157 N92-15284

PORTUGAL

- Turbulent energy budgets in impinging zones p 17 A92-40081

- Measurements and modelling of the turbulent near wake flow of a disk with a central jet p 174 A92-40123
- The turbulence characteristics of a single impinging jet through a crossflow p 180 A92-47676
- An integral calculation method for incompressible three-dimensional boundary layers in axisymmetric diffusers p 180 A92-48206
- Fatigue management for the A-7P p 79 N92-18593
- Validation of non-orthogonal three-dimensional laminar flow predictions p 199 N92-27476

R

ROMANIA

- A subclass of viscoelastic fluids connected with admissible von Karman solutions p 182 A92-51891
- Organized structures in the developing region of axisymmetric jet flow p 182 A92-51892
- A direct viscous-inviscid interaction method for the flow calculation around airfoils p 24 A92-52028
- An aerodynamical analysis of 'seesaw' type rotor for autogyro p 24 A92-52034
- On the recovery of the giant fuel tanks of spacecrafts [IAF PAPER 92-0878] p 128 A92-57266

S

SPAIN

- Gravitational effects on flame spreading over thin cylindrical fuel samples p 147 A92-14020
- Asymptotic techniques for the analysis of fluid systems p 163 A92-16229
- Madrid's double airport p 110 A92-16231
- Viscous-inviscid interaction due to the freezing of a liquid flowing on a flat plate p 163 A92-16455
- New practical method for measurement error determination in radar systems under real traffic conditions p 155 A92-17238
- A theoretical approach to impulsive motion of viscous liquid bridges p 165 A92-22124
- ARINC and commercial aircraft avionics. I p 60 A92-25655
- Gravity effects on reproduction, development, and aging p 244 A92-34193
- Aircraft financing in Spain p 280 A92-35593
- ARINC and the avionics of commercial aircraft. II p 60 A92-37072
- Iberia's Aeronautical Mapping Application (ACAII) p 60 A92-37073
- Use of the thrust-weight diagram versus transport cargo in the initial dimensioning of passenger-transport aircraft p 71 A92-37074
- Convection-induced shears for general planforms p 177 A92-44352
- Optimum cruise lift coefficient in initial design of jet aircraft p 73 A92-46806
- Patch-independent structured multiblock grids for CFD computations p 263 A92-47078
- Differential GPS algorithms evaluation for navigation between two LEO spacecraft during rendez-vous p 129 A92-48478
- Brownian-motion limited aerodynamic focusing of heavy molecules p 182 A92-52722
- Investigation of the tail buffeting of the C-101 p 26 A92-53253
- The Hermes nominal landing sites [IAF PAPER 92-0884] p 125 A92-57272
- Corrosion tests of meshes in carbon fiber laminates: Impact beam tests [INFORME-I-522/90] p 145 N92-10068
- Flow and temperature computations for space vehicles using adaptive finite element techniques p 35 N92-14990
- Electronically steerable antenna for aircraft p 156 N92-15272
- Application of eddy current techniques to graphite composite materials [ETN-92-90815] p 145 N92-21416
- Measurement of the flow distribution over the flight deck of an aircraft carrier p 194 N92-21955
- Relegation of the proper rotation in attitude dynamics of a spacecraft p 138 N92-24728
- Planetary vision as a strategy p 229 N92-25243
- Study on the requirements for the installation of a CES and habitability centre p 254 N92-27007
- Fuzzy guidance system evaluation p 259 N92-27903
- Unsteady transonic aerodynamics of pointed bodies of revolution in supersonic freestream p 45 N92-27946

SWEDEN

- Numerical simulation of unsteady viscous compressible flows applied to blade flutter analysis [ASME PAPER 91-GT-203] p 93 A92-15625
- JAS 39 Gripen progress report p 67 A92-16058

FOREIGN TECHNOLOGY INDEX

- Sweden and the space plane - A small country with high ambition [AIAA PAPER 91-5005] p 119 A92-17804
- Aerospace software in Sweden p 255 A92-19406
- Fatigue and damage tolerance verification of aircraft structures p 217 A92-19677
- Damage tolerance of the fighter aircraft 37 Viggen. I - Analytical assessment. II - Experimental verification p 68 A92-19819
- The use of finite difference electromagnetic analysis in the design and verification of modern aircraft p 68 A92-20136
- Signatures of transient boundary layer processes observed with Viking p 230 A92-24532
- Numerical simulations of flows around flame holders [AIAA PAPER 92-0557] p 168 A92-26967
- Three-dimensional unsteady flow calculations in both intake port and combustion chamber [AIAA PAPER 92-0833] p 169 A92-29599
- Well-posedness in the generalized sense for boundary layer suppressing boundary conditions p 170 A92-31399
- Swedish user support for Columbus p 120 A92-32469
- A velocity-pressure streamline diffusion finite element method for the incompressible Navier-Stokes equations p 172 A92-37504
- Adaptive streamline diffusion methods for compressible flow using conservation variables p 172 A92-37535
- Well-posedness in the generalized sense for the incompressible Navier-Stokes equation p 262 A92-37789
- GPS/GLONASS user systems in Sweden p 61 A92-38384
- Inter-noise 90: Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vols. 1 & 2 [ISBN 91-7848-224-0] p 266 A92-39042
- Mechanical noise from large wind turbines - Experiences from Swedish prototypes p 226 A92-39046
- Propeller aircraft interior noise - Physical background and possible treatments p 71 A92-39082
- Coupled propeller contributions to aircraft noise and vibration p 266 A92-39085
- Propeller sound excitation on an aircraft fuselage using a loudspeaker ring p 72 A92-39087
- JAS 39 Gripen flight test report p 72 A92-40030
- Transition to turbulence in curved channel flow p 18 A92-40125
- Extrapolation procedures for the time-dependent Navier-Stokes equations p 19 A92-41289
- Generation of efficient multiblock grids for Navier-Stokes computations p 263 A92-47081
- Combustion calculations on a premixed system with a bluff body flameholder [AIAA PAPER 92-3470] p 147 A92-49017
- Review of applications and of extended power density of 4-cylinder, in-line and hermetic Stirling engine p 212 A92-50779
- The Swedish space program p 121 A92-53452
- Performance improvements and fuel cost savings due to leading edge modification of a vintage delta wing jet fighter [FFA-TN-1991-22] p 76 N92-11993
- A review of aeronautical fatigue investigations in Sweden during the period May 1989 to April 1991 [FFA-TN-1991-24] p 219 N92-12313
- Acoustic characteristics of anechoic chamber at FFA [FFA-TN-1990-43] p 268 N92-12599
- Aeroacoustics in inhomogeneous flow field [FFA-TN-1991-30] p 268 N92-12601
- Validation of a computational method for laminar hypersonic flow around blunt bodies and the application to the full Hermes spacecraft p 34 N92-14978
- Hypersonic flow past delta wing flow simulated by Navier-Stokes solutions p 34 N92-14981
- Implementation of the total quality management concept within space business p 275 N92-18640
- Wind tunnel force measurements and visualization on a 60-deg delta wing in oscillation, stepwise motion, and gusts p 80 N92-18786
- Commission for Aeronautical Meteorology. Abridged final report of the ninth session [WMO-752] p 240 N92-18911
- MATGRID: A program for generation of C-H and C-O topology grids around wing/body configurations. Mathematical definition document [FFA-TN-1990-19] p 41 N92-20468
- Esrang: Sounding rocket and balloon facility p 126 N92-20720
- Hypersonic laminar flow computations over a blunt leading edged delta wing at three different chord Reynolds numbers [FFA-TN-1991-40] p 43 N92-23168
- The structural optimization system OPTSYS: Current status and applications p 83 N92-23232

The need of coordinated observations in space and ground p 233 N92-26310
Finite element methods for flow problems p 200 N92-27672
Recent applications of linear and nonlinear unsteady aerodynamics for aeroelastic analysis p 44 N92-27940

A manufacturer's approach to ensure long term structural integrity p 57 N92-30133
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: Software description document p 50 N92-30713
[FFA-TN-1990-20]
Vibro-acoustic FE analyses of the Saab 2000 aircraft p 270 N92-32952

SWITZERLAND

Quasi-three-dimensional characteristics method for a supersonic compressor rotor [ASME PAPER 91-GT-81] p 7 A92-15549
Cardiological aspects of pilot's fitness to fly p 245 A92-16406
Twilight of the machine builders p 279 A92-20515
Insurance turns the corner p 278 A92-20516
Numerical fluid mechanics - Incompressible flows with complex boundaries [ISBN 3-540-53137-8] p 169 A92-29649
The view from the airport p 60 A92-33438
Non-equilibrium hypersonic flow simulations using the second-order boundary layer equations p 16 A92-37551

Investigation of flame-generated turbulence in premixed flames at low and high burning velocities p 172 A92-38868
Vorticity shedding and acoustic resonance in an in-line tube bundle. I - Vorticity shedding. II - Acoustic resonance p 176 A92-43045
Mesh adaption for 2D transonic Euler flows on unstructured meshes p 22 A92-47038
Basic considerations in development cooperation - The application of remote sensing in developing and newly industrialized countries p 281 A92-49454
Ill-posedness of a shock-fitting problem for Parabolized Navier-Stokes equations p 182 A92-50477
Changes observed in lymphocyte behavior during gravitational unloading p 247 A92-52395
A multiblock flow solver for inviscid hypersonic flows p 34 N92-14986
Mikado: A graphic program p 190 N92-16237
On the determination of turbulent mixing coefficients from Eulerian current data p 195 N92-22121
On the analysis of liquid filled free-free tanks p 196 N92-23843
Separation of external stores: Comparison of results [F+W-TF-2058] p 85 N92-26944
Control concepts for active magnetic bearings p 214 N92-27743

T

TURKEY

Orientation and control of a flexible spacecraft - Planar motion p 130 A92-11348
Effect of turbulence modeling on dynamic stall of a NACA0012 airfoil [AIAA PAPER 92-0027] p 11 A92-22149
The TSE 310 troubleshooting expert prototype for the Airbus A-310 commercial aircraft p 2 A92-25180
Cylinder-induced shock-wave boundary-layer interaction p 15 A92-31188
Determination of aircraft noise levels while the engine is running on the ground - An approach from the point of urbanization and architecture p 227 A92-39064
Computer simulation of an unsteady flow around an airfoil with a spoiler p 19 A92-43167
3-D numerical grid generation for the transonic flow analysis about multi-bodies p 22 A92-47061
Laminar channel flow over a square step p 180 A92-48254
Stresses in rotating, orthotropic, circular, composite disks and plates p 218 A92-51745
Trimming rotor blades with periodically deflecting trailing edge flaps p 106 A92-56283
The initial boundary-layer flow past a translating and spinning rotational symmetric body p 185 A92-57449
Numerical simulation of vortex street-edge interaction p 33 N92-13027

U

UNITED KINGDOM

High resolution schemes for steady flow computation p 161 A92-10036
Long-lived polar thermospheric vortices - A combined radar and optical study p 230 A92-10629

Flying the A340 iron bird p 67 A92-10666
Steady and unsteady 3D interactive boundary layers p 161 A92-10689
Joining of composite materials to metals p 211 A92-10695
Cognitive quality and situational awareness with advanced aircraft attitude displays p 251 A92-11131
Decision support in the cockpit - Probably a good thing? p 251 A92-11135
VSTOL aircraft flight control system design using H(infinity) controllers and a switching strategy p 103 A92-11561
An assessment of robustness of variable structure control systems for advanced aircraft manoeuvres p 103 A92-11595
Soviet space at the crossroads p 118 A92-11881
Dornier Do.328 special - Examining the high-speed commuter p 67 A92-11882
Accurate current measurement using drogued buoys employing Decca Navigator and Argos p 241 A92-12278
Analysis and design optimization of monopulse receivers for secondary surveillance radar p 155 A92-12299
The development status of the Space Technology Research Vehicle [IAF PAPER 91-008] p 118 A92-12433
Stress and error in aviation p 249 A92-13015
The development of a working model of flight crew underload p 249 A92-13019
The long-term psychological consequences of a major aircraft accident p 249 A92-13020
The importance of the Type II error in aviation safety research p 250 A92-13027
Solution of the Reynolds-averaged Navier-Stokes equations for transonic aerofoil flows p 6 A92-13198
The aerodynamic interference between a flapped tanker aircraft and a receiver aircraft during air-to-air refuelling p 103 A92-13199
Secondary separation from a slender wing p 6 A92-13448
Tomorrow's cockpit displays p 88 A92-13699
Mind that restyle p 53 A92-13700
Human resource management in aviation p 250 A92-13837
A conceptualization of aviation psychology on the civil flight deck p 250 A92-13849
Neutron superfluid spin-down and magnetic field decay in pulsars p 283 A92-13865
Aircraft measurements and model comparisons of water vapour continuum absorption in the 10-12 micron (800-1000 per cm) region p 235 A92-13977
Lifting line predictions for a swept tip rotor blade p 7 A92-14424
Effects of atomic oxygen on spacecraft materials - Simulation and measurement [IAF PAPER 91-305] p 130 A92-14722
High temperature multiaxial creep testing of Nimonic 115 p 148 A92-15202
A review of rigid body response on sting supported models at high angles of incidence p 7 A92-15345
A dynamics parameter invariant attitude control system for flexible spacecraft p 130 A92-15384
Eigenvalue realisation methods for the in-orbit identification of large flexible spacecraft structures p 131 A92-15410
An Axial Turbopump [ASME PAPER 91-GT-1] p 211 A92-15501
Turbulence modelling for secondary flow prediction in a turbine cascade [ASME PAPER 91-GT-57] p 7 A92-15535
The simulation of three-dimensional viscous flow in turbomachinery geometries using a solution-adaptive unstructured mesh methodology [ASME PAPER 91-GT-124] p 8 A92-15569
Inviscid-viscous coupled solution for unsteady flows through vibrating blades. II - Computational results [ASME PAPER 91-GT-126] p 8 A92-15571
An experiment on unsteady flow over an oscillating airfoil [ASME PAPER 91-GT-181] p 8 A92-15613
The design and testing of a radial flow turbine for aerodynamic research [ASME PAPER 91-GT-220] p 93 A92-15636
Film cooling research on the endwall of a turbine nozzle guide vane in a short duration annular cascade. I - Experimental technique and results [ASME PAPER 91-GT-252] p 162 A92-15657
Discharge coefficients of cooling holes with radiused and chamfered inlets [ASME PAPER 91-GT-269] p 162 A92-15667
Design and performance of advanced blading for a high-speed HP compressor [ASME PAPER 91-GT-374] p 9 A92-15718
The selective bleed variable cycle engine [ASME PAPER 91-GT-388] p 93 A92-15720

A simple model to simulate subsonic intakes and propelling nozzles of aircraft gas turbine engines [ASME PAPER 91-GT-392] p 162 A92-15722
Analysis of the resonance angle of Cosmos 1603 (1984-106 A) near 14:1 resonance p 122 A92-15808
Application of a satellite aerodynamics model based on normal and tangential momentum accommodation coefficients p 123 A92-15818
The linear inviscid secondary instability of longitudinal vortex structures in boundary layers p 163 A92-16032
Vortex instabilities in three-dimensional boundary layers - The relationship between Goertler and crossflow vortices p 163 A92-16043
Legal capacity of Eurocontrol to ensure smooth aviation in Europe p 279 A92-16134
The weightless experience p 245 A92-16403
Radiation exposure of aircrew p 246 A92-16409
Delivered with feeling p 103 A92-16621
Mirage 2000-5 - Dassault's delta described p 67 A92-16622
The application of high pressure ejectors to reaction control systems p 93 A92-16666
Isothermal modeling of gas turbine combustors - Computational study p 93 A92-17203
The United Kingdom perspective on the applications of aerospace planes in the 21st century [AIAA PAPER 91-5084] p 119 A92-17852
Tomorrow's Goshawk flies p 68 A92-18001
Hypersonic materials p 143 A92-18002
Heavy metal p 110 A92-18100
Communication satellite system beyond the year 2000 [IAF PAPER 91-495] p 155 A92-18509
Noise-driven flow p 10 A92-18680
Large chord turbine cascade testing at engine Mach and Reynolds number p 10 A92-18771
Mesoscale dynamics of cold fronts - Structures described by drop soundings in Fronts 87 p 235 A92-18902
Infra-red offers new landing aid competition p 88 A92-18937
Impact of aircraft and surface emissions of nitrogen oxides on tropospheric ozone and global warming p 226 A92-19193
Requirements p 255 A92-19382
Aerospace software engineering in the United Kingdom p 255 A92-19405
Crack initiation and the short-to-long crack growth transition in a Ni-base superalloy p 148 A92-19767
Asymmetric oscillations in thermosolutal convection p 164 A92-19964
Whole aircraft lightning indirect effects evaluation using low level injection techniques p 68 A92-20134
Four decades of transonic fighter design p 68 A92-20203
Atomic oxygen protection of carbon and polycarbonate using boron carbide coating p 150 A92-20393
Fractal dimensions and spectra of interfaces with application to turbulence p 164 A92-20511
Organizational impediments to the reduction of costs of space programmes [IAF PAPER 91-639] p 278 A92-20591
Airport terminals p 110 A92-21125
Clever cockpits p 1 A92-21700
Computational methods in viscous aerodynamics p 11 A92-21976
High costs force avionics links p 88 A92-22000
Parallel algorithms for panel methods p 165 A92-22346
Computation of normal impinging jets in cross-flow and comparison with experiment p 11 A92-22446
How accurately can we predict the errors in satellite cloud-motion winds? p 236 A92-22607
Reducing risks p 278 A92-22725
Welding of Ti 6Al 4V using a high power solid state laser with fibre delivery p 210 A92-22773
Cost effective solutions for titanium sheet metal forming p 211 A92-22785
In situ measurements of the ice water content in cirrus clouds p 236 A92-22952
A fire field model implemented in a parallel computing environment p 166 A92-23252
A simple proof of existence of weak and statistical solutions of Navier-Stokes equations p 166 A92-23256
Adding the time-dependent terms to a segregated finite element solution of the incompressible Navier-Stokes equations p 166 A92-23289
Transition to cooperative ATM system requires commitment p 59 A92-23297
Operational aspects of spacecraft autonomy p 131 A92-24207
The roll-up of vorticity strips on the surface of a sphere p 167 A92-24751
The jet edge-tone feedback cycle - Linear theory for the operating stages p 167 A92-24758

The avoidance of collisions for Newtonian bodies with hidden variables p 59 A92-24945

European studies to investigate the feasibility of using 1000 ft vertical separation minima above FL 290. II - Precision radar data analysis and collision risk assessment p 59 A92-24946

A study of reversion behaviour in 8090 alloys using small angle neutron scattering and transmission electron microscopy p 149 A92-25026

Tilting at targets p 68 A92-25074

Damping down the fires p 53 A92-25075

The use of variable camber to reduce drag, weight and costs of transport aircraft p 12 A92-25096

Derivation of the aerodynamic roughness parameters for a Sahelian Savannah site using the eddy correlation technique p 236 A92-25198

Behind the screens p 59 A92-25520

The real TCAS p 54 A92-25521

Anglo-American avionics p 2 A92-25575

The evaluation of canard couplings at high angles of attack [AIAA PAPER 92-0281] p 12 A92-25735

An efficient Euler solver for predominantly supersonic flows with embedded subsonic pockets [AIAA PAPER 92-0323] p 12 A92-25770

MA alloys for aerospace applications p 149 A92-26128

Embedded meshes of controllable quality synthesised from elementary geometric features [AIAA PAPER 92-0663] p 261 A92-27034

Unsteady three-dimensional Benard convection - Light-scattering, statistics and chaos p 168 A92-27379

Boundary singularities in steady potential compressible flow through plane two-dimensional channels p 14 A92-27384

Internal flow modelling of vortex throttles p 168 A92-27385

Cell vertex finite volume discretizations in three dimensions p 168 A92-27475

On the relation between total ozone and meteorology p 236 A92-27796

A study of the interaction of a normal shock wave with a turbulent boundary layer at Mach numbers between 1.30 and 1.55 p 14 A92-28006

Using Rankine vortices to model flow around a body of revolution p 169 A92-28061

Spacecraft in-orbit identification using eigensystem realization methods p 132 A92-28133

The other missiles p 2 A92-28184

36th Roy Chadwick Lecture - Manufacturing breakout 1941-1991: Development in aerospace industry manufacturing techniques p 2 A92-28941

Impinging jets in cross-flow p 169 A92-28942

Meeting VSTOL aircraft performance requirements using scheduled H(infinity) controllers p 103 A92-29094

Dornier 328 - A Daimler for commuters p 69 A92-30091

Airbus - The family expands p 2 A92-30092

Gosling p 286 A92-30101

Skylark sounding rockets - Past and present p 286 A92-30108

The Venusian polar dipole p 285 A92-30456

The upper atmosphere as sensed by satellite orbits p 230 A92-30638

Calculations of the dilution system in an annular gas turbine combustor p 170 A92-31164

Measurement of field-aligned currents by the SABRE coherent scatter radar p 231 A92-31271

Mixing by chaotic advection in a class of spatially periodic flows p 170 A92-31451

Kinematic simulation of homogeneous turbulence by unsteady random Fourier modes p 170 A92-31460

A 3D finite element multigrid solver for the Euler equations [AIAA PAPER 92-0449] p 171 A92-31665

Aero-propulsive effects on configuration shaping [AIAA PAPER 91-5064] p 69 A92-31691

Nonlinear interaction of oblique three-dimensional Tollmien-Schlichting waves and longitudinal vortices, in channel flows and boundary layers p 171 A92-32228

Heat transfer effects on aerodynamics and implications for wind-tunnel tests p 171 A92-32240

The Second Goldstein Lecture: Modern developments in fluid dynamics - An addendum p 15 A92-32323

The first fifty years of composite materials in aircraft construction p 69 A92-32325

Columbus VII - Symposium on Space Station Utilization, 7th, Anacapri, Italy, July 1-6, 1991, Proceedings p 119 A92-32451

A comparison of satellite sounding data and aircraft measurements within a mature polar low p 237 A92-32489

The use of large teams in conceptual aircraft design [AIAA PAPER 92-1092] p 274 A92-33257

Sentinel 1000 flight test programme overview and preliminary results [AIAA PAPER 92-1229] p 69 A92-33326

The design challenge of a long endurance airship [AIAA PAPER 92-1266] p 69 A92-33344

Modelling of aerospace materials - Not just a pretty picture p 212 A92-33363

Spacecraft systems engineering [ISBN 0-471-92794-5] p 120 A92-33401

The space environment and its effects on spacecraft design p 120 A92-33403

Dynamics of spacecraft p 123 A92-33404

Atmospheric re-entry p 123 A92-33409

Spacecraft structures p 132 A92-33410

Thermal control of spacecraft p 132 A92-33413

Spacecraft electromagnetic compatibility engineering p 132 A92-33417

A European perspective on the co-operative air traffic management concept p 60 A92-33427

A family of two-dimensional nonlinear solutions for magnetic field annihilation p 272 A92-33574

Aircraft performance [ISBN 0-521-36264-4] p 69 A92-33919

The mortality of British Airways pilots, 1966-1989 - A Proportional Mortality study p 246 A92-34257

Mass-transporter p 69 A92-34650

Radiometric observations at 89 and 157 GHz of atmospheric and surface properties measured from an aircraft p 222 A92-35034

JPATS escape system development p 70 A92-35434

Insurers lose from high-risk deals p 279 A92-35474

Why composites wait in the wings p 144 A92-35475

The use of inverse simulation for conceptual design p 70 A92-35738

Tail rotor aerodynamic features recorded in flight p 70 A92-35752

Rotor aeromechanics research with the RAE research Lynx - The experimental facility and test programme p 70 A92-35767

Handling and performance considerations when conducting air-to-air refuelling of large aircraft by the probe and drogue system p 71 A92-35937

Australian space - Looking for a direction p 120 A92-36073

The engine inside p 94 A92-36126

The bullish bear p 2 A92-36350

Space law and space technology - A common language p 281 A92-36695

Experimental investigation of supersonic flow over two cavities in tandem p 15 A92-36830

The computation of three-dimensional flows using unstructured grids p 16 A92-37539

Adaptive methods in computational fluid dynamics of chemically reacting flows p 172 A92-37573

Rafale M - Dassault's Squal at sea p 71 A92-37874

NASA's quiet side. I p 3 A92-37875

On inertial waves in the earth's fluid core p 231 A92-37905

Ageing airliner census - Still flying safely p 54 A92-38374

Flying on thin ice p 54 A92-38375

Pilot disorientation as the most frequent cause of fatal, weather-related accidents in UK civil and general aviation p 250 A92-38382

Aviation meteorology p 237 A92-38383

World Congress on Computational Mechanics, 2nd, Universitaet Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers p 262 A92-38401

The UK Parliamentary Space Committee - The emergence of a space lobby? p 281 A92-38793

Flow regimes of the cove regions between a slat and wing and between a wing and flap of a multi-element airfoil p 16 A92-38858

High temperature superconducting vortex flow transistor p 159 A92-38971

Noise from military airfields in the United Kingdom p 226 A92-39052

Airport noise contours - Converting from NNI to Leq p 227 A92-39053

Do we really need 57 ways of rating aircraft noise? p 227 A92-39065

A survey of active control in aircraft cabins p 72 A92-39084

Evaluation of sound transmission into aircraft fuselages by a reciprocity technique p 266 A92-39086

Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990 [ISBN 0-903409-78-X] p 54 A92-39301

Civil aircraft design in relation to airworthiness p 54 A92-39303

Aircraft structural design p 72 A92-39304

How to promote error tolerance in complex systems in the context of ships and aircraft p 152 A92-39308

Engine reliability p 95 A92-39309

Learning from aircraft accidents and incidents p 54 A92-39310

Airport technology international 1992 p 111 A92-39514

Design of low-sensitivity modalized observers using left eigenstructure assignment p 104 A92-39908

Concorde flight testing - Powerplant and performance flying [SAE PAPER 912192] p 72 A92-40009

British Airways Airbus A320 pilots' autothrust survey [SAE PAPER 912225] p 54 A92-40023

RAE Bedford VAAC research project p 104 A92-40039

Bursts and sources of pressure fluctuation in turbulent boundary layers p 17 A92-40055

Computation of impinging flows using second-moment closures p 173 A92-40083

Three-dimensional separated flows p 173 A92-40088

Second moment closure predictions of jet-on-jet impingement flows p 173 A92-40102

Flow structure and mixing in obstructed and confined jets p 174 A92-40107

Computations of a separated turbulent boundary layer p 174 A92-40131

Progress and paradoxes in modelling near-wall turbulence p 174 A92-40158

Natural frequencies of a rotating cable/spacecraft system p 132 A92-40547

Vibration analysis of gas turbines by an intelligent knowledge-based system p 95 A92-40548

Recent research into the aerodynamics of ASTOVL aircraft in ground environment p 18 A92-40549

Shear progress p 3 A92-40880

On a class of unsteady three-dimensional Navier-Stokes solutions relevant to rotating disc flows - Threshold amplitudes and finite-time singularities p 175 A92-41655

Re-entry aerodynamics derived from space debris trajectory analysis p 123 A92-41764

A numerical simulation of boundary layer effects in a shock tube p 176 A92-42300

Windscreens departure p 55 A92-42500

The 1991 Cierva Lecture - Aberdeen and its influence on the evolution of the commercial IFR twin engine helicopter p 55 A92-43446

An experimental investigation of the oblique blade-vortex interaction p 19 A92-43447

Eurocontrol and airport liens and some other rights of detention/forfeiture of aircraft p 281 A92-43550

Spectacular return for Columbia - Oldest Shuttle to make 13-day science mission p 128 A92-43596

The UK element of the Maestro-1 SAR campaign p 223 A92-44167

On the development of Goertler vortices in wall jet flow p 177 A92-44801

Assembling the future p 3 A92-44895

Pilot attitudes to cockpit automation p 250 A92-44926

The development of an intelligent human factors data base as an aid for the investigation of aircraft accidents p 277 A92-44994

The effect on aircraft evacuations of passenger behaviour and smoke in the cabin p 55 A92-44998

Helicity in laminar and turbulent flow p 177 A92-45089

A laser light sheet investigation into transonic external aerodynamics p 207 A92-45136

International Powered Lift Conference, London, England, Aug. 29-31, 1990, Proceedings [ISBN 0-903409-68-2] p 3 A92-45302

VSTOL engine design evolution - Growth of the Pegasus engine for Harrier p 95 A92-45306

Evolution of ASTOVL aircraft design p 72 A92-45311

Recent developments at the Shoeburyness STOVL test facility p 111 A92-45314

Configuration effects on the ingestion of hot gas into the engine intake p 73 A92-45315

Hot-gas reingestion - Engine response considerations p 95 A92-45317

Prediction and measurement of jet flowfield features for ASTOVL aircraft p 20 A92-45318

A progress report on ASTOVL control concept studies under the VAAC programme p 104 A92-45319

ASTOVL engine control p 95 A92-45321

Integrated flight control systems - Architectural considerations for future aircraft concepts p 104 A92-45322

Ground surface erosion - British Aerospace test facility and experimental studies p 111 A92-45323

- The experimental and computational study of jet impingement flowfields with reference to VSTOL aircraft performance p 20 A92-45324
- Test techniques for metal matrix composites; Proceedings of the Meeting, London, England, Nov. 28, 1990 p 144 A92-45335
- [ISBN 0-85498-530-1] p 144 A92-45335
- Introduction to metal matrix composites and a review of their potential uses p 144 A92-45336
- Test requirements for metal matrix composites (MMC) in aerospace applications p 144 A92-45337
- Application of an unstructured Navier-Stokes solver to multi-element airfoils operating at transonic maneuver conditions p 20 A92-45507
- [AIAA PAPER 92-2638] p 20 A92-45507
- Prediction of the viscous transonic aerodynamic performance of supercritical aerofoil sections [AIAA PAPER 92-2653] p 21 A92-45569
- Calculation of potential flow around airfoils using a discrete vortex method p 21 A92-45827
- Fibre optic rotary position sensors for vehicle and propulsion controls p 90 A92-46243
- The use of optical sensors and signal processing gas turbine engines p 90 A92-46247
- Melting and dissolving p 178 A92-46260
- Direct simulation Monte Carlo calculations of rarefied flows with incomplete surface accommodation p 178 A92-46261
- The nonlinear stability of flows over compliant walls p 179 A92-46265
- Propulsion system performance and integration for high Mach air breathing flight p 96 A92-46429
- The inviscid compressible Goertler problem in three-dimensional boundary layers p 22 A92-46441
- Sunrise aerospace p 3 A92-46448
- Through the looking glass p 90 A92-46449
- The application of particle image velocimetry (PIV) in a short-duration transonic annular turbine cascade [ASME PAPER 91-GT-221] p 179 A92-46825
- Effect of model cooling on periodic transonic flow p 22 A92-46900
- Mesh adaptivity with the quadtree method p 22 A92-47041
- Solution of the two-dimensional compressible Navier-Stokes equations on embedded structured multiblock meshes p 179 A92-47056
- The construction, application and interpretation of three-dimensional hybrid meshes p 263 A92-47089
- Generation of unstructured grids within a hybrid multi-block environment p 23 A92-47090
- Rotation of the neutron-drip superfluid in pulsars - The Kelvin phonon contribution to dissipation p 284 A92-47146
- The coupling between radiation and dynamics in the stratosphere p 238 A92-47733
- The effects of resolution on diagnostic calculations of coupling between radiation and dynamics p 238 A92-47734
- CIS engines. I - The range revealed p 4 A92-47821
- Procurement doubts threaten research p 275 A92-47974
- US Navy revisits escape modules p 73 A92-47975
- Computation of the flow and heat transfer due to a rotating disc p 180 A92-48203
- Experience with the Johnson-King turbulence model in a transonic turbine cascade flow solver p 23 A92-48207
- Time-to-go estimation from infrared images p 61 A92-48308
- An integrated navigation system manager using federated Kalman filtering p 90 A92-48477
- Robustness characteristics of fast-sampling digital PI controllers for high-performance aircraft with impaired control surfaces p 105 A92-48496
- The iterative solution of Taylor-Galerkin augmented mass matrix equations p 263 A92-49445
- Numerical simulation of jet-forced flow in a circular reservoir using discrete and random vortex methods p 181 A92-49511
- The simulation of inviscid, compressible flows using an upwind kinetic method on unstructured grids p 24 A92-49515
- A comparison of measured and modeled broadband fluxes from aircraft data during the ICE '89 field experiment p 238 A92-49771
- Addressing the challenge of aircraft component design and manufacture from metal matrix composites p 144 A92-50007
- Development of active control technology for the next generation of combat aircraft p 106 A92-50008
- British Aerospace Hawk into the 1990s p 73 A92-50009
- A review of scale effects in unsteady aerodynamics p 24 A92-50121
- Impingement of an axisymmetric jet on unheated and heated flat plates p 182 A92-50297
- An integrated approach to developing tough epoxies p 145 A92-51563
- BA's 777 p 74 A92-51580
- The role of diffusive effects on potential vorticity in fronts p 238 A92-51781
- Water-vapour continuum absorption in the tropics - Aircraft measurements and model comparisons p 239 A92-51784
- 'Space objects', 'astronauts', and related expressions p 281 A92-51854
- 777 shaping up p 74 A92-52300
- Optical micromachined pressure sensor for aerospace applications p 208 A92-52370
- A general explicit or semi-explicit algorithm for compressible and incompressible flows p 25 A92-52682
- Heat transfer to a delta wing and two waverider wings in rarefied hypersonic flow p 25 A92-52748
- Progress towards quieter civil helicopters p 267 A92-52847
- The numerical simulation of flow about installed aero engine nacelle using a finite element Euler solver on unstructured meshes p 26 A92-52848
- The application of a theoretical blade sailing model to predict the behaviour of articulated helicopter rotors p 74 A92-52849
- The near millimetre wavelength optical constants of calcium lanthanum sulphide p 272 A92-52965
- Steels for aerospace applications p 149 A92-52983
- Nonlinear development and secondary instability of large-amplitude Goertler vortices in hypersonic boundary layers p 26 A92-53080
- Silent solutions p 96 A92-53120
- Regional challenge p 74 A92-53121
- Russian realities p 4 A92-53250
- Dual technique magnetometer experiment for the Cassini Orbiter spacecraft p 139 A92-53412
- The Electron Spectrometer for the Cassini spacecraft p 140 A92-53415
- Solar sail expedition to the moon and Mars - Mission update p 121 A92-53430
- Recent developments in data acquisition and control systems at the Aircraft Research Association Limited p 112 A92-54323
- Particle image velocimetry measurements of the aerodynamics of a wind turbine p 208 A92-54337
- The interaction between a high-frequency gust and a blade row p 267 A92-54484
- The structure of a turbulent free shear layer in a rotating fluid p 183 A92-54487
- Stabilization and destabilization of turbulent shear flow in a rotating fluid p 183 A92-54488
- Rapidly going nowhere? p 74 A92-54545
- CIS engines - The range revealed. II p 96 A92-54546
- Joining a Ni-based creep-resistant (ODS) alloy by brazing p 212 A92-54867
- Space terminology - The case for a common language [IAF PAPER 92-0368] p 277 A92-55773
- Alpha-GMRES - A new parallelizable iterative solver for large sparse non-symmetric linear systems arising from CFD p 184 A92-56125
- Lynx - A 50 year product? p 75 A92-56307
- Technology exploitation for in-service support of future rotorcraft p 4 A92-56327
- A study of helicopter rotor/fuselage response in low-speed manoeuvres - Comparison of theory with flight p 107 A92-56334
- Measurements of the dynamic stall vortex convection speed p 27 A92-56351
- Extended Ly Alpha emission around quasars at z of more than 3.6 p 247 A92-56703
- Comparison of recent results from different wind tunnel facilities along with comparisons of measured flight results and wind tunnel based predictions [AIAA PAPER 92-3985] p 75 A92-56809
- A comparison of numerical predictions and experiments on under-expanded jets p 141 A92-56849
- [AIAA PAPER 92-4027] p 141 A92-56849
- A dynamic stiffness technique for the vibration analysis of stiffened shell structures p 219 A92-56866
- Space development scenarios - A new framework for evaluation [IAF PAPER ST-92-0002] p 282 A92-57353
- An aerodynamic consideration of the re-entry and aerobreaking environment of space vehicles [IAF PAPER ST-92-0017] p 27 A92-57363
- A history of the scientific study of living organisms in space [IAF PAPER ST-92-0022] p 254 A92-57366
- The design of spaceborne synthetic aperture radar [ETN-91-99986] p 156 A92-10114
- Jet noise classical theory and experiments p 268 A92-10602
- Airframe noise p 268 A92-10605
- Parallel processing applications for gas turbine engine control p 96 A92-11012
- Radial inflow turbine study [AD-A240169] p 96 A92-11015
- Drag coefficients with applications to satellite orbits p 133 A92-11069
- An examination of the factors affecting the use of infra-red search and track systems in the air-to-air role [ETN-91-99987] p 156 A92-11222
- Pitching moment derivative due to rate of pitch for projectiles at supersonic speeds [ESDU-91004] p 28 A92-11967
- Lift-curve slope of wing-body combinations [ESDU-91007] p 28 A92-11968
- Effect of twin fins on isolated tailplane lift-curve slope [ESDU-91009] p 28 A92-11969
- Maximum lift of wings with trailing-edge flaps at low speeds [ESDU-91014] p 28 A92-11970
- Application of Eigenstructure Assignment to the control of powered lift combat aircraft [RAE-TM-FS-1009] p 107 A92-12004
- Heat transfer and instrumentation studies on rotating turbine blades in a transient facility p 186 A92-12203
- Blade surface pressure measurements on the rotor of a model turbine stage in a transient flow facility p 186 A92-12206
- Military and civil software standards and guidelines for guidance and control p 257 A92-12452
- Formal verification of a redundancy management algorithm p 257 A92-12457
- Software methodologies for safety critical systems p 257 A92-12467
- Development of tactical decision aids p 90 A92-12532
- Integrating machine intelligence into the cockpit to aid the pilot p 252 A92-12533
- A review of UK aviation policy [TT-9107] p 5 A92-12988
- Comparison of solution of various Euler solvers and one Navier-Stokes solver for the flow about a sharp-edged cropped delta wing [AD-B163639L] p 30 A92-12998
- Review of aircraft dynamic loads due to flow separation p 31 A92-13008
- Asymmetric vortex flow over circular cones p 32 A92-13014
- An experimental investigation of the effect of fineness ratio on lateral force on a pointed slender body of revolution p 32 A92-13015
- Control of forebody vortices by suction at the nose of the RAE high incidence research model p 32 A92-13022
- An experimental investigation of vortex flaps on a canard combat-aircraft configuration p 33 A92-13023
- Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE] p 55 A92-14007
- Avionics software evolution p 91 A92-14052
- Effect of viscous damping on the response of floating bodies p 187 A92-14303
- Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] p 187 A92-14319
- The stratospheric residual circulation as deduced from satellite data p 232 A92-14498
- Interference heating near fin/body junctions on hypersonic vehicles p 36 A92-14996
- Hypersonic aerothermodynamic computations using a point-implicit TVD method p 37 A92-15006
- The dynamic response of separated hypersonic flows p 38 A92-15019
- A method of estimating a flow breakdown boundary for aerofoils and swept wings in transonic flows [ESDU-91021] p 39 A92-15970
- Contribution of fin and tailplane to sideforce and yawing moment derivatives due to sideslip at supersonic speeds at low angles of attack [ESDU-91031] p 39 A92-15971
- Excrescence drag magnification factors at the drag-rise condition for aerofoils with a specified form of upper-surface pressure distribution [ESDU-91029] p 39 A92-15973
- Energy height method for flight path optimisation. Addendum A: Numerical method suitable for rapid use on IBM PC compatible computers [ESDU-91016-ADD] p 77 A92-15987
- Estimation of airborne performance in landing [ESDU-91032] p 77 A92-15988
- Variability of standard aircraft performance parameters [ESDU-91020] p 77 A92-17847
- Mean wind speeds over hills and other topography [ESDU-91043] p 240 A92-17853
- Sydney Goldstein FRS Hon FRAeS: An appreciation [AERO-REPT-8903] p 286 A92-17928

Physical and computational modelling of stratified shear flows
[AERO-REPT-8909] p 190 N92-17974
Prediction of far-field harmonic noise from propellers
[ESDU-91033] p 269 N92-18074
A survey of the numerical simulation of unsteady flows past cavities (with aerodynamic applications)
[AERO-REPT-9002] p 190 N92-18088
Modelling of interfacial and thermocline waves
[AERO-REPT-9006] p 243 N92-18089
Statistical methods applicable to analysis of aircraft performance data
[ESDU-91017] p 77 N92-18096
Marching with the parabolized Navier-Stokes equations. Problem 1: Numerical study of hypersonic viscous cone flow
[AERO-REPT-9007] p 40 N92-18231
Marching with the parabolized Navier-Stokes equations. Problem 2: Hypersonic viscous flow over a flat plate
[AERO-REPT-9008] p 40 N92-18232
Modelling of interfacial and thermocline waves
[AERO-REPT-9011] p 243 N92-18234
Computation of laminar flow over cavities
[AERO-REPT-9013] p 191 N92-18235
The laminar natural convection on a horizontal surface
[AERO-REPT-9015] p 191 N92-18236
The flow past bluff bodies by a vortex method
[AERO-REPT-9016] p 191 N92-18291
Model parameter identification techniques for flight flutter testing
[AERO-REPT-9105] p 107 N92-18294
Propagation of shock waves through clouds
[AERO-REPT-9104] p 191 N92-18317
Towards the computation of turbulent hypersonic flows
[AERO-REPT-9106] p 40 N92-18318
On the approximate representation of velocity and shear stress distributions in low-speed boundary layers
[AERO-REPT-9012] p 192 N92-18319
Numerical solutions for uniform flow around symmetrical bodies using panel methods
[AERO-REPT-9014] p 192 N92-18320
Aircraft aerodynamics and stability and control during air-to-air refueling
[AERO-REPT-9017] p 107 N92-18321
The Goldstein Engineering Research Laboratory
[AERO-REPT-8906] p 5 N92-18322
Modelling of interfacial and thermocline waves
[AERO-REPT-9004] p 243 N92-18340
The installation of the AVRO 9 by 7 foot low-speed wind tunnel at the University of Manchester (England)
[AERO-REPT-9005] p 114 N92-18341
Aircraft fatigue management in the Royal Air Force
p 79 N92-18591
Reliability modeling of the systems whose components have non-constant failure rate
p 216 N92-18648
Sector based logic and practice of international companies in the fields of data management and technology transfer
p 278 N92-18661
Advanced tactical fighter engine
[ETN-92-90840] p 97 N92-18728
Use of stepwise regression techniques and kinematic compatibility for the analysis of EAP flight data
p 81 N92-18790
Dynamic wind tunnel tests on control of forebody vortices with suction
p 107 N92-18793
The 8th Symposium on Turbulent Shear Flows. Volume 1: Sessions 1-18
[AD-A243809] p 192 N92-18933
The 8th Symposium on Turbulent Shear Flows. Volume 2: 19-31, poster sessions.
[AD-A243810] p 192 N92-18934
Pulmonary effects of high-G and positive pressure breathing
p 248 N92-18978
Advances in the design of military aircrew breathing systems with respect to high altitude and high acceleration conditions
p 252 N92-18999
High altitude high acceleration and NBC warfare protective system for advanced fighter aircraft: Design considerations
p 252 N92-19000
Introduction: Needs and approaches to reliability and quality assurance in design and manufacture
p 216 N92-19005
Fixed wing night attack EO integration and sensor fusion
p 253 N92-19009
The RAF Institute of Aviation Medicine proposed helmet fitting/retention system
p 253 N92-19013
Reduction of target scattering by tropospheric modification
p 157 N92-19164
Robust control system design with application to high performance helicopters
p 108 N92-19621
Experimental studies of vortex flaps and vortex plates. Part 1: 0.53 m span 60 deg delta wing
[CRANFIELD-AERO-9113-PT-1] p 40 N92-19679
A study of the aeroelastic behaviour of helicopter rotor blades featuring swept tips
p 81 N92-19701

Some aspects of shock capturing methods for gas dynamics
[CRANFIELD-AERO-9112] p 192 N92-19916
A linearised Riemann solver for Godunov-type methods
[CRANFIELD-AERO-9116] p 265 N92-19924
Materials and process directions for advanced aero-engine design
[PNR-90814] p 98 N92-19938
Re-engineing appears to offer best payback for young: Chapter 2 compliant aircraft
[PNR-90848] p 98 N92-19939
Use of CFD in the design of a modern multistage aero engine LP turbine design
[PNR-90862] p 98 N92-20179
Experimental and analytical studies of jets in quiescent or rotating flow fields
p 193 N92-20317
The requirements and management of quality audits and reviews
[PNR-90840] p 275 N92-20458
ETOPS: A developing scene
[PNR-90844] p 98 N92-20459
The impact of aircraft noise control technology
[PNR-90846] p 269 N92-20461
Application of a water droplet trajectory prediction code to the design of inlet particle separator anti-icing systems
[PNR-90839] p 98 N92-20573
The environmental impact of commercial aviation: The evolution of exhaust emissions legislation and control technology
[PNR-90847] p 228 N92-20574
Why is space software special?
p 258 N92-20626
An evaluation of in-cabin safety features in passenger aircraft
[ETN-92-90656] p 55 N92-20794
A fatigue analysis of the TF89 tactical fighter aircraft
[ETN-92-90657] p 81 N92-20795
The role of crack growth in defect assessment
[PNR-90798] p 220 N92-20909
High temperature processing and deformation of a near-alpha titanium alloy
[PNR-90853] p 149 N92-20911
Keys to excellence in design and manufacture
[PNR-90781] p 276 N92-20927
The environmental challenges for the next supersonic aircraft
[PNR-90782] p 228 N92-20928
A review of icing research at the Royal Aerospace Establishment
p 56 N92-21689
Emissions from aircraft: Standards and potential for improvement
[PNR-90768] p 98 N92-21740
Practical application of 3-D CFD methods to gas turbine combustors
[PNR-90773] p 194 N92-21742
Environmentally sound
[PNR-90776] p 228 N92-21743
The search for new materials
[PNR-90777] p 145 N92-21744
UK airmisses involving commercial air transport: September - December 1990
[ETN-92-91050] p 56 N92-21746
The proposed revision to RTCA DO178A and its influence on system design
[PNR-90821] p 258 N92-21847
Compressing the compressor
[PNR-90824] p 99 N92-21848
The evolution of the bypass engine
[PNR-90832] p 99 N92-21850
EC funding of collaborative research projects
[PNR-90833] p 279 N92-21851
Approach and landing guidance
p 65 N92-21960
United Kingdom approach to deriving military ship helicopter operating limits
p 82 N92-21966
Some implications for advanced STOVL operation from invincible class ships
p 82 N92-21971
Recent developments at the Shoeburyness (England) STOVL Test Facility
[PNR-90806] p 115 N92-22096
Impact of regulation changes on engine design and certification
[PNR-90789] p 99 N92-22098
The problem of static pressure measurement in turbomachinery annuli using traversable instrumentation
[PNR-90791] p 194 N92-22099
Vorticity measurements in the near wake of a bluff body at low Reynolds numbers
[AERO-REPT-9102] p 195 N92-22100
A theoretical investigation of the induced drag of wing of finite aspect ratio
[CUED/A-AERO/TR-17(1991)] p 43 N92-22193
Boundary layer transition on concave surfaces
p 195 N92-22200
Separation of relaminarised boundary layers
[CUED/A-AERO/TR-16] p 195 N92-22209

Risk to hearing from overflight noise of military aircraft
[ISVR-TR-194] p 270 N92-22241
Aircraft gas turbine emissions: Their nature, technology for reduction, and a pollution comparison with channel tunnel transport
[ETN-92-91056] p 99 N92-22406
Applications of boundary integral methods to the study of steep free surface waves
p 195 N92-23149
Application of an automated multidisciplinary analysis and optimisation system to the design of aircraft structures
p 83 N92-23233
Simultaneous stress and flutter optimization for the wing of a transport aircraft equipped with four engines
p 108 N92-23238
Surface activation of Concorde by Be-7
p 271 N92-23295
Survey of experimental techniques for performance prediction
p 84 N92-23954
Debris reentry prediction: Salyut-7/Kosmos-1686
p 125 N92-23973
Normal force of low aspect ratio wing-body combinations up to high angles of attack at supersonic speeds
[ESDU-91042] p 84 N92-24009
Implementation of Inmarsat mobile satcom systems
p 157 N92-24073
Aeronautical satellite system test and implementation
p 158 N92-24095
Inmarsat aeronautical mobile satellite system: Internetworking issues
p 158 N92-24098
Future developments in aeronautical satellite communications
p 158 N92-24167
Boundary layers and transition on concave surfaces
p 196 N92-24341
Design aspects of the attitude control system for the SOHO spacecraft
p 135 N92-24433
Low cost spacecraft attitude sensors
p 140 N92-24458
Object-oriented simulation in diagnosis and recovery from faults in spacecraft subsystems: An experimental application of the Olympus AOCS
p 136 N92-24493
Some aspects of the attitude and orbit control subsystem of the Olympus spacecraft
p 137 N92-24504
The dynamics of the Cluster spacecraft
p 137 N92-24510
Turbulence modelling in CFD: Present status, future prospects
p 197 N92-24515
Limitation of space debris in geostationary transfer orbit
p 125 N92-24774
Pre-qualification level testing of an 80 K Stirling cycle cooler
p 154 N92-25851
The development of a range of low vibration mechanical cryocoolers for space application
p 154 N92-25853
Air purification systems for submarines and their relevance to spacecraft
p 253 N92-25892
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-190353] p 43 N92-25959
Antarctic studies of the cusp
p 233 N92-26301
Requirements for coordinated Cluster and ground-based observations of the cusp
p 233 N92-26318
Tracer transport in the middle atmosphere
p 229 N92-26473
Cell vertex methods for compressible gas flows
p 197 N92-26599
Critical technologies: Spacecraft habitability, an update
p 254 N92-27010
Concept for a European Space Station: Habitability, life support, and laboratory facilities
p 254 N92-27023
VSTOL engine design evolution: Growth of the Pegasus engine for Harrier
[PNR-90805] p 99 N92-27039
ASTOVL engine control
[PNR-90808] p 100 N92-27040
ASTOVL propulsion systems: Configuration and concept choice
[PNR-90809] p 100 N92-27041
The changing role of experimentation in aeroengine R and D: The point of view of the research worker
[AD-A246372] p 100 N92-27062
Exposure to space radiation of high-performance infrared multilayer filters and materials technology experiment (A0056)
p 272 N92-27108
Oxygen isotopes implanted in the LDEF spacecraft
p 272 N92-27284
Thermally sprayed coating systems for surface protection and clearance control applications in aero engines
[PNR-90802] p 100 N92-27422
Application of S1BYL2 to the AGARD WG18 compressor test cases
p 198 N92-27452
Experimental verification of a 3D turbulent flow calculation in an axial turbine cascade
p 198 N92-27457
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
p 101 N92-27466

The application of a Navier-Stokes CFD method to civil engine intake flows p 199 N92-27471

Computational modelling of turbulent flow in S-bends p 199 N92-27480

Modelling the vaporiser and primary zone flows for a modern gas turbine combustion chamber p 101 N92-27484

Unstructured grid methods for compressible flows p 201 N92-27676

Magnetic suspension using high temperature superconducting cores p 161 N92-27789

Wind tunnel magnetic Suspension Systems at the University of Southampton, England p 115 N92-27804

Interdiction mission planning and co-ordination during the Gulf conflict 17 January - 27 February 1991 p 264 N92-27888

Transonic aeroelastic calculations in both the time and frequency domains p 46 N92-27950

A review of scale effects on surfaces in unsteady motion p 46 N92-27962

Instability and transition in compressible boundary layers p 201 N92-28062

[AD-A248596] Radial inflow turbine study p 101 N92-28073

[AD-A246938] Applications of silicon hybrid multi-chip modules to avionics p 92 N92-28379

Practical considerations in designing the engine cycle p 102 N92-28460

Inlet distortion effects in aircraft propulsion system integration p 102 N92-28464

Fundamentals of structural optimisation p 86 N92-28470

Validation of simulation systems for aircraft acceptance testing p 86 N92-28531

Initial validation of a R/D simulator with large amplitude motion p 116 N92-28546

Effective cueing during approach and touchdown: Comparison with flight p 117 N92-28552

Turbulent spot generation and growth rates in a transonic boundary layer p 202 N92-29118

[AD-A250221] Boundary layer induced noise in aircraft p 270 N92-29201

[CUED/A-AERO/TR-18] Evaluation of a Solent sonic anemometer on RRS Charles Darwin Cruise 43 p 243 N92-29213

[IOS-288-1991] The e-beam sustained laser technology for space-based Doppler wind lidar p 240 N92-29300

Dynamic solder management p 150 N92-29647

[AD-A250564] Aeronautical Engineering Group publications, 1950 - present p 202 N92-29683

[AERO-REPT-8907] Technical evaluation report on the Flight Mechanics Panel Symposium on Piloted Simulation Effectiveness [AGARD-AR-315] p 118 N92-30769

An investigation into the interface between three closely spaced axi-symmetric bodies at subsonic speed p 50 N92-31514

[CRANFIELD-AERO-9114] ASTOVL combat aircraft design synthesis and optimization p 88 N92-31515

[CRANFIELD-AERO-9201] Aerodynamic centre of wing-body combinations p 50 N92-32479

[ESDU-92024] A background to the handling qualities of aircraft p 109 N92-32780

[ESDU-92006] Lift and rolling moment due to spoilers on wings with trailing-edge flaps deflected at subsonic speeds p 51 N92-32782

[ESDU-92002-SUPPL] Spray nozzle for fire control p 205 N92-32856

[CA-PATENT-APPL-SN-2-011-94] Aspects of compression in aerospace composites: Future requirements p 146 N92-33036

Radial inflow turbine study p 214 N92-33538

[AD-A252783] Re-engining for real stage 3 compliance p 102 N92-33748

[PNR-90872] The Rolls-Royce Trent p 88 N92-33750

[PNR-90875] The impact of air transport on the environment p 230 N92-33751

[PNR-90876] Remote sensing of seasonal variations in albedo over southern Britain p 241 N92-33969

Finite element simulation of viscoelastic flow p 205 N92-34038

Yacht sail aerodynamics. Part 1: Optimising overall performance p 52 N92-70499

[TT-8903-PT-1] Yacht sail aerodynamics. Part 3: Achievable jibsail specification p 52 N92-70513

[ISBN-0-904947-17-3] Yacht sail aerodynamics. Part 2: Achievable mainsail specification p 52 N92-70514

[ISBN-0-904947-16-5]

Symposium on dynamic balancing

p 221 N92-71104

Y

YUGOSLAVIA

Disturbance of transonic wind tunnel flow by a slot in the tunnel wall p 110 A92-13675

The multiparameter method of a boundary layer on thin bodies of revolution p 165 A92-21613

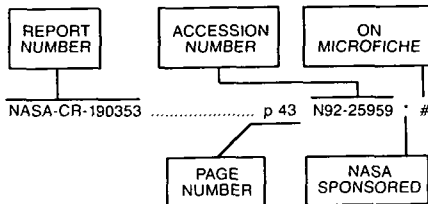
Entropy production in gaseous boundary layers p 183 A92-52814

REPORT NUMBER INDEX

EUROPEAN AEROSPACE SCIENCE AND TECHNOLOGY 1992 / A Bibliography with Indexes

JUNE 1993

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

AAAF-NT-89-12	p 112	N92-11020	#
AAAF-NT-89-28	p 185	N92-11288	#
AAS PAPER 91-364	p 123	A92-43262	
AAS PAPER 91-543	p 124	A92-43391	
AD-A240169	p 96	N92-11015	#
AD-A241072	p 232	N92-13512	#
AD-A241597	p 187	N92-14319	#
AD-A242025	p 261	N92-12517	#
AD-A243084	p 242	N92-17169	#
AD-A243809	p 192	N92-18933	#
AD-A243810	p 192	N92-18934	#
AD-A244244	p 91	N92-14046	#
AD-A244245	p 244	N92-13547	#
AD-A244249	p 30	N92-12996	#
AD-A244250	p 75	N92-11001	#
AD-A244869	p 81	N92-21951	#
AD-A245302	p 80	N92-18778	#
AD-A245623	p 158	N92-25378	#
AD-A246281	p 277	N92-18659	#
AD-A246297	p 55	N92-21679	#
AD-A246372	p 100	N92-27062	#
AD-A246775	p 243	N92-28365	#
AD-A246925	p 252	N92-19008	#
AD-A246938	p 101	N92-28073	#
AD-A247719	p 83	N92-23950	#
AD-A247742	p 108	N92-20026	#
AD-A248257	p 83	N92-23227	#
AD-A248270	p 41	N92-20797	#
AD-A248596	p 201	N92-28062	#
AD-A250221	p 202	N92-29118	#
AD-A250564	p 150	N92-29647	#
AD-A252783	p 214	N92-33538	#
AD-A253004	p 146	N92-33033	#
AD-A253005	p 44	N92-27706	#
AD-A253088	p 5	N92-27887	#
AD-A253603	p 44	N92-27936	#
AD-A253647	p 198	N92-27450	#
AD-A253805	p 85	N92-28468	#
AD-A253824	p 101	N92-28458	#
AD-A255373	p 85	N92-28469	#
AD-A255713	p 264	N92-32229	#
AD-A256061	p 200	N92-27671	#
AD-B155447L	p 150	N92-70307	
AD-B155451L	p 213	N92-16313	#
AD-B155452L	p 52	N92-70249	
AD-B156440L	p 77	N92-15065	#
AD-B158639L	p 41	N92-20473	#
AD-B158641L	p 115	N92-18416	#
AD-B158649L	p 41	N92-20498	#
AD-B158646L	p 108	N92-20475	#
AD-B159047L	p 64	N92-19491	#
AD-B159157L	p 286	N92-13916	#

AD-B159336L	p 191	N92-18221	#
AD-B163639L	p 30	N92-12998	#
AD-B163670L	p 30	N92-12997	#
AERO-REPT-8903	p 286	N92-17928	#
AERO-REPT-8906	p 5	N92-18322	#
AERO-REPT-8907	p 202	N92-29683	#
AERO-REPT-8909	p 190	N92-17974	#
AERO-REPT-9002	p 190	N92-18088	#
AERO-REPT-9004	p 243	N92-18340	#
AERO-REPT-9005	p 114	N92-18341	#
AERO-REPT-9006	p 243	N92-18089	#
AERO-REPT-9007	p 40	N92-18231	#
AERO-REPT-9008	p 40	N92-18232	#
AERO-REPT-9011	p 243	N92-18234	#
AERO-REPT-9012	p 192	N92-18319	#
AERO-REPT-9013	p 191	N92-18235	#
AERO-REPT-9014	p 192	N92-18320	#
AERO-REPT-9015	p 191	N92-18236	#
AERO-REPT-9016	p 191	N92-18291	#
AERO-REPT-9017	p 107	N92-18321	#
AERO-REPT-9102	p 195	N92-22100	#
AERO-REPT-9104	p 191	N92-18317	#
AERO-REPT-9105	p 107	N92-18294	#
AERO-REPT-9106	p 40	N92-18318	#
AERONOMICA-ACTA-F-42-1991	p 287	N92-30996	
AFOSR-92-0214TR	p 201	N92-28062	#
AFOSR-92-0365TR	p 202	N92-29118	#
AGARD-AG-324	p 244	N92-13547	#
AGARD-AG-329	p 92	N92-28376	#
AGARD-AR-270	p 41	N92-20797	#
AGARD-AR-274	p 108	N92-20026	#
AGARD-AR-280	p 75	N92-11001	#
AGARD-AR-299	p 50	N92-30947	#
AGARD-AR-310	p 264	N92-32229	#
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AGARD-AR-312	p 85	N92-28468	#
AGARD-AR-315	p 118	N92-30769	#
AGARD-CAL-90/2	p 275	N92-17198	#
AGARD-CAL-92/1	p 275	N92-17212	#
AGARD-CP-494	p 30	N92-12996	#
AGARD-CP-496	p 55	N92-21679	#
AGARD-CP-497	p 80	N92-18778	#
AGARD-CP-499	p 261	N92-12517	#
AGARD-CP-500	p 92	N92-32437	#
AGARD-CP-504	p 5	N92-27887	#
AGARD-CP-507	p 44	N92-27936	#
AGARD-CP-509	p 81	N92-21951	#
AGARD-CP-510	p 198	N92-27450	#
AGARD-CP-516	p 247	N92-18972	#
AGARD-CP-517	p 252	N92-19008	#
AGARD-LS-176	p 91	N92-14046	#
AGARD-LS-181	p 277	N92-18659	#
AGARD-LS-183	p 101	N92-28458	#
AGARD-LS-186	p 85	N92-28469	#
AGARD-R-783	p 83	N92-23950	#
AGARD-R-784	p 83	N92-23227	#
AGARD-R-785	p 146	N92-33033	#
AGARD-R-786	p 44	N92-27706	#
AGARD-R-787	p 200	N92-27671	#
AIAA PAPER 91-4099	p 128	A92-24357	#
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AIAA PAPER 91-5005	p 119	A92-17804	#
AIAA PAPER 91-5013	p 126	A92-17811	#
AIAA PAPER 91-5031	p 49	N92-29713	#
AIAA PAPER 91-5039	p 94	A92-17827	#
AIAA PAPER 91-5041	p 48	N92-29649	#
AIAA PAPER 91-5084	p 69	A92-31691	#
AIAA PAPER 91-5084	p 119	A92-17852	#
AIAA PAPER 91-5086	p 1	A92-17854	#
AIAA PAPER 92-0015	p 94	A92-22137	#
AIAA PAPER 92-0027	p 11	A92-22149	#
AIAA PAPER 92-0072	p 255	A92-22185	#
AIAA PAPER 92-0073	p 256	A92-22186	#

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AIAA PAPER 92-0323	p 12	A92-25770	#
AIAA PAPER 92-0419	p 168	A92-26269	#
AIAA PAPER 92-0449	p 171	A92-31665	#
AIAA PAPER 92-0557	p 168	A92-26967	#
AIAA PAPER 92-0663	p 261	A92-27034	#
AIAA PAPER 92-0833	p 169	A92-29599	#
AIAA PAPER 92-1003	p 127	A92-33195	#
AIAA PAPER 92-1092	p 274	A92-33257	#
AIAA PAPER 92-1145	p 123	A92-33286	#
AIAA PAPER 92-1229	p 69	A92-33326	#
AIAA PAPER 92-1266	p 69	A92-33344	#
AIAA PAPER 92-1955	p 140	A92-31709	#
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AIAA PAPER 92-2613	p 20	A92-45487	#
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AIAA PAPER 92-2638	p 20	A92-45507	#
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AIAA PAPER 92-2668	p 20	A92-45523	#
AIAA PAPER 92-2704	p 21	A92-45546	#
AIAA PAPER 92-2720	p 21	A92-45558	#
AIAA PAPER 92-2731	p 21	A92-45565	#
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AIAA PAPER 92-2929	p 180	A92-47899	#
AIAA PAPER 92-2967	p 273	A92-46982	#
AIAA PAPER 92-3040	p 24	A92-48701	#
AIAA PAPER 92-3041	p 24	A92-48702	#
AIAA PAPER 92-3327	p 260	A92-48910	#
AIAA PAPER 92-3469	p 181	A92-49016	#
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AIAA PAPER 92-3513	p 132	A92-49046	#
AIAA PAPER 92-3760	p 96	A92-49115	#
AIAA PAPER 92-3860	p 141	A92-54208	#
AIAA PAPER 92-3944	p 112	A92-56773	#
AIAA PAPER 92-3956	p 112	A92-56784	#
AIAA PAPER 92-3972	p 112	A92-56798	#
AIAA PAPER 92-3985	p 75	A92-56809	#
AIAA PAPER 92-4003	p 209	A92-56826	#
AIAA PAPER 92-4027	p 141	A92-56849	#
AIAA PAPER 92-4328	p 106	A92-55172	#
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AIAA PAPER 92-4378	p 260	A92-55182	#
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AIAA PAPER 92-4501	p 27	A92-55369	#
AIAA PAPER 92-4510	p 124	A92-52080	#
AIAA PAPER 92-4646	p 124	A92-55401	#
ASME PAPER 91-GT-114	p 8	A92-15565	
ASME PAPER 91-GT-124	p 8	A92-15569	
ASME PAPER 91-GT-126	p 8	A92-15571	
ASME PAPER 91-GT-168	p 8	A92-15603	
ASME PAPER 91-GT-181	p 8	A92-15613	
ASME PAPER 91-GT-1	p 211	A92-15501	
ASME PAPER 91-GT-201	p 214	A92-15624	
ASME PAPER 91-GT-203	p 93	A92-15625	
ASME PAPER 91-GT-220	p 93	A92-15636	
ASME PAPER 91-GT-221	p 179	A92-46825	
ASME PAPER 91-GT-252	p 162	A92-15657	
ASME PAPER 91-GT-259	p 214	A92-15661	
ASME PAPER 91-GT-269	p 162	A92-15667	
ASME PAPER 91-GT-294	p 94	A92-36889	
ASME PAPER 91-GT-312	p 8	A92-15689	
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ASME PAPER 91-GT-374	p 9	A92-15718	
ASME PAPER 91-GT-388	p 93	A92-15720	
ASME PAPER 91-GT-392	p 162	A92-15722	
ASME PAPER 91-GT-55	p 7	A92-15533	
ASME PAPER 91-GT-57	p 7	A92-15535	
ASME PAPER 91-GT-59	p 7	A92-15536	
ASME PAPER 91-GT-81	p 7	A92-15549	
B-235387	p 113	N92-13076	#
BCRS-91-25	p 230	N92-29499	#
BCRS-91-28	p 225	N92-30230	#
BLL-MO-TRANS-1705(5733.360)	p 241	N92-70048	
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BR303122	p 55	N92-14007	#	ESDU-68022	p 84	N92-24009	ETN-92-90700	p 187	N92-14319	#
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CA-PATENT-APPL-SN-2-011-945	p 205	N92-32856		ESDU-91004	p 28	N92-11967	ETN-92-90729	p 62	N92-19041	#
CEAT-M5-5443/01	p 76	N92-14042	#	ESDU-91007	p 28	N92-11968	ETN-92-90731	p 232	N92-19292	#
CERB-91-07	p 253	N92-19926	#	ESDU-91009	p 28	N92-11969	ETN-92-90738	p 64	N92-20902	#
CERT-RF-1/3369-00/DERI-GAN	p 28	N92-10988	#	ESDU-91014	p 28	N92-11970	ETN-92-90748	p 287	N92-19411	#
CERT-RF-39/5025-36	p 192	N92-19294	#	ESDU-91016-ADD	p 77	N92-15987	ETN-92-90750	p 152	N92-19413	#
CERT-RF-67/5004-37	p 186	N92-12211	#	ESDU-91017	p 77	N92-18096	ETN-92-90751	p 216	N92-19108	#
CERT-RT-63/5618-54	p 185	N92-11306	#	ESDU-91020	p 77	N92-17847	ETN-92-90754	p 193	N92-19932	#
CERT-RT-65/5604-35	p 185	N92-11307	#	ESDU-91021	p 39	N92-15970	ETN-92-90755	p 192	N92-19916	#
CERT-RTS-55/5018-45	p 186	N92-12210	#	ESDU-91029	p 39	N92-15973	ETN-92-90760	p 98	N92-21740	#
CERT-2/7724-DERA	p 108	N92-19295	#	ESDU-91031	p 39	N92-15971	ETN-92-90763	p 194	N92-21742	#
CIT-REF-06/769E(5)	p 96	N92-11015	#	ESDU-91032	p 77	N92-15988	ETN-92-90764	p 228	N92-21743	#
CNRS-RC-91-1	p 50	N92-31508	#	ESDU-91033	p 269	N92-18074	ETN-92-90765	p 145	N92-21744	#
CONF-911080-1	p 195	N92-23120	#	ESDU-91042	p 84	N92-24009	ETN-92-90767	p 276	N92-20927	#
CP-504S	p 264	N92-32229	#	ESDU-91043	p 240	N92-17853	ETN-92-90768	p 228	N92-20928	#
CP-504	p 264	N92-32229	#	ESDU-92002-SUPPL	p 51	N92-32782	ETN-92-90772	p 220	N92-20909	#
CRANFIELD-AERO-9112	p 192	N92-19916	#	ESDU-92006	p 109	N92-32780	ETN-92-90775	p 99	N92-27039	#
CRANFIELD-AERO-9113-PT-1	p 40	N92-19679	#	ESDU-92024	p 50	N92-32479	ETN-92-90776	p 115	N92-22096	#
CRANFIELD-AERO-9114	p 50	N92-31514	#	ETN-91-90041	p 113	N92-12005	ETN-92-90777	p 100	N92-27040	#
CRANFIELD-AERO-9116	p 265	N92-19924	#	ETN-91-90059	p 145	N92-10068	ETN-92-90778	p 100	N92-27041	#
CRANFIELD-AERO-9201	p 88	N92-31515	#	ETN-91-90075	p 28	N92-10988	ETN-92-90782	p 98	N92-19938	#
CTN-92-60391	p 205	N92-32856		ETN-91-90077	p 186	N92-12210	ETN-92-90785	p 258	N92-21847	#
CUED/A-AERO/TR-16	p 195	N92-22209	#	ETN-91-90078	p 186	N92-12211	ETN-92-90786	p 99	N92-21848	#
CUED/A-AERO/TR-17(1991)	p 43	N92-22193	#	ETN-91-90079	p 185	N92-11306	ETN-92-90788	p 99	N92-21850	#
CUED/A-AERO/TR-18	p 270	N92-29201	#	ETN-91-90080	p 185	N92-11307	ETN-92-90789	p 279	N92-21851	#
DE91-633612	p 273	N92-70166		ETN-91-90082	p 76	N92-11009	ETN-92-90792	p 98	N92-20573	#
DE92-007831	p 195	N92-23120	#	ETN-91-90084	p 185	N92-11308	ETN-92-90793	p 275	N92-20458	#
DE92-614464	p 284	N92-22653	#	ETN-91-90086	p 186	N92-11310	ETN-92-90794	p 98	N92-20459	#
DE92-615083	p 217	N92-23258	#	ETN-91-90087	p 29	N92-11972	ETN-92-90796	p 269	N92-20461	#
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DLR-FB-90-09	p 205	N92-33996	#	ETN-91-90097	p 286	N92-11963	ETN-92-90798	p 98	N92-19939	#
DLR-FB-90-17	p 232	N92-19292	#	ETN-91-90100	p 29	N92-11973	ETN-92-90801	p 149	N92-19911	#
DLR-FB-90-26	p 48	N92-29159	#	ETN-91-90101	p 29	N92-11979	ETN-92-90809	p 153	N92-20921	#
DLR-FB-90-33	p 211	N92-34152	#	ETN-91-90102	p 29	N92-11980	ETN-92-90815	p 145	N92-21416	#
DLR-FB-90-34	p 58	N92-31943	#	ETN-91-90106	p 29	N92-11981	ETN-92-90820	p 85	N92-26944	#
DLR-FB-90-46	p 113	N92-12005	#	ETN-91-90107	p 186	N92-12215	ETN-92-90840	p 97	N92-18728	#
DLR-FB-91-09	p 113	N92-12005	#	ETN-91-90108	p 187	N92-12216	ETN-92-90843	p 99	N92-22098	#
DLR-FB-91-23	p 64	N92-20902	#	ETN-91-90109	p 29	N92-11982	ETN-92-90844	p 194	N92-22099	#
DLR-FB-91-28	p 270	N92-29997	#	ETN-91-90110	p 113	N92-12006	ETN-92-90845	p 100	N92-27422	#
DLR-FB-91-30	p 233	N92-26329	#	ETN-91-90136	p 29	N92-11973	ETN-92-90851	p 98	N92-20179	#
DLR-FB-91-34	p 92	N92-29870	#	ETN-91-90169	p 156	N92-12156	ETN-92-90867	p 192	N92-19349	#
DLR-MITT-91-08	p 62	N92-19041	#	ETN-91-90176	p 160	N92-12184	ETN-92-90870	p 192	N92-19294	#
DLR-MITT-91-10	p 158	N92-29877	#	ETN-91-90187	p 187	N92-12219	ETN-92-90871	p 108	N92-19295	#
DLR-MITT-91-12	p 58	N92-31813	#	ETN-91-90195	p 219	N92-14382	ETN-92-90872	p 269	N92-21736	#
DRIC-BR-307984	p 100	N92-27062	#	ETN-91-90199	p 62	N92-10996	ETN-92-90873	p 115	N92-20385	#
ESA-BR-76	p 152	N92-19413	#	ETN-91-90209	p 62	N92-10997	ETN-92-90875	p 269	N92-20387	#
ESA-PSS-01-20-ISSUE-2	p 216	N92-19108	#	ETN-91-90258	p 156	N92-12157	ETN-92-90912	p 286	N92-17928	#
ESA-PSS-01-21-ISSUE-2	p 257	N92-14631	#	ETN-91-90259	p 242	N92-12386	ETN-92-90917	p 190	N92-17974	#
ESA-PSS-01-50-ISSUE-1	p 217	N92-29878	#	ETN-91-90265	p 152	N92-12146	ETN-92-90919	p 190	N92-18088	#
ESA-PSS-04-104-VOL-1-ISSUE-2	p 156	N92-14268	#	ETN-91-90267	p 145	N92-12065	ETN-92-90921	p 243	N92-18340	#
ESA-SP-1131-REV-1	p 287	N92-19411	#	ETN-91-90284	p 268	N92-12599	ETN-92-90922	p 114	N92-18341	#
ESA-SP-1141	p 122	N92-29879	#	ETN-91-90287	p 76	N92-11993	ETN-92-90923	p 243	N92-18089	#
ESA-SP-316	p 152	N92-18607	#	ETN-91-90288	p 219	N92-12313	ETN-92-90924	p 40	N92-18231	#
ESA-SP-318	p 33	N92-14973	#	ETN-91-90289	p 268	N92-12601	ETN-92-90925	p 40	N92-18232	#
ESA-SP-321-VOL-1	p 133	N92-23780	#	ETN-91-90293	p 5	N92-12988	ETN-92-90928	p 243	N92-18234	#
ESA-SP-323	p 135	N92-24432	#	ETN-91-90294	p 107	N92-12004	ETN-92-90929	p 191	N92-18235	#
ESA-SP-324-VOL-1	p 138	N92-25828	#	ETN-91-99900	p 282	N92-25758	ETN-92-90930	p 191	N92-18236	#
ESA-SP-326	p 122	N92-24719	#	ETN-91-99953	p 112	N92-11020	ETN-92-90931	p 191	N92-18291	#
ESA-SP-327	p 127	N92-23750	#	ETN-91-99969	p 185	N92-11288	ETN-92-90933	p 195	N92-22100	#
ESA-SP-328	p 158	N92-25668	#	ETN-91-99986	p 156	N92-10114	ETN-92-90936	p 191	N92-18317	#
ESA-SP-342	p 125	N92-20715	#	ETN-91-99987	p 156	N92-11222	ETN-92-90937	p 107	N92-18294	#
ESA-SP-345	p 134	N92-23967	#	ETN-92-90317	p 219	N92-14397	ETN-92-90938	p 40	N92-18318	#
ESA-TT-1229	p 148	N92-31942	#	ETN-92-90319	p 55	N92-14007	ETN-92-90939	p 192	N92-18319	#
ESA-TT-1235	p 49	N92-30514	#	ETN-92-90320	p 257	N92-14631	ETN-92-90940	p 192	N92-18320	#
ESA-TT-1237	p 205	N92-33996	#	ETN-92-90323	p 156	N92-14268	ETN-92-90941	p 107	N92-18321	#
ESA-TT-1247	p 48	N92-29159	#	ETN-92-90392	p 187	N92-14321	ETN-92-90942	p 5	N92-18322	#
ESA-TT-1251	p 211	N92-34152	#	ETN-92-90414	p 187	N92-14325	ETN-92-90952	p 192	N92-18323	#
ESA-TT-1254	p 58	N92-31943	#	ETN-92-90415	p 188	N92-14326	ETN-92-90954	p 64	N92-19491	#
ESDU-AERO-A.S.01.03.01	p 28	N92-11968		ETN-92-90416	p 33	N92-14004	ETN-92-90956	p 191	N92-18221	#
ESDU-PERF-EG6/3	p 77	N92-15988		ETN-92-90420	p 77	N92-14045	ETN-92-90959	p 115	N92-18416	#
				ETN-92-90432	p 77	N92-15065	ETN-92-90961	p 41	N92-20473	#
				ETN-92-90454	p 147	N92-14141	ETN-92-90962	p 41	N92-20498	#
				ETN-92-90457	p 188	N92-14328	ETN-92-90965	p 108	N92-20475	#
				ETN-92-90460	p 152	N92-18607	ETN-92-90989	p 129	N92-20476	#
				ETN-92-90462	p 189	N92-16226	ETN-92-90998	p 42	N92-21703	#
				ETN-92-90567	p 211	N92-17434	ETN-92-90999	p 194	N92-21704	#
				ETN-92-90578	p 151	N92-18479	ETN-92-91000	p 40	N92-19296	#
				ETN-92-90592	p 107	N92-15072	ETN-92-91006	p 194	N92-21232	#
				ETN-92-90602	p 215	N92-17544	ETN-92-91008	p 194	N92-21234	#
				ETN-92-90610	p 282	N92-15938	ETN-92-91014	p 193	N92-20180	#
				ETN-92-90614	p 78	N92-18333	ETN-92-91026	p 284	N92-20477	#
				ETN-92-90616	p 145	N92-17310	ETN-92-91050	p 56	N92-21746	#
				ETN-92-90617	p 39	N92-17311	ETN-92-91052	p 40	N92-19679	#
				ETN-92-90618	p 190	N92-17312	ETN-92-91054	p 265	N92-19924	#
				ETN-92-90619	p 42	N92-22179	ETN-92-91056	p 99	N92-22406	#
				ETN-92-90620	p 77	N92-17313	ETN-92-91058	p 41	N92-20468	#
				ETN-92-90621	p 40	N92-17314	ETN-92-91062	p 269	N92-21237	#
				ETN-92-90622	p 40	N92-17315	ETN-92-91063	p 65	N92-25590	#
				ETN-92-90624	p 209	N92-17344	ETN-92-91068	p 287	N92-24351	#
				ETN-92-90656	p 55	N92-20794	ETN-92-91075	p 193	N92-20230	#
				ETN-92-90657	p 81	N92-20795	ETN-92-91077	p 193	N92-20232	#
				ETN-92-90660	p 240	N92-18911	ETN-92-91080	p 41	N92-19682	#
				ETN-92-90679	p 286	N92-15961	ETN-92-91082	p 41	N92-19925	#
				ETN-92-90680	p 33	N92-14973	ETN-92-91083	p 253	N92-19926	#
							ETN-92-91161	p 213	N92-21993	#

ETN-92-91187	p 134	N92-23967	#	ETN-92-91877	p 225	N92-30230	#	IAF PAPER 92-0354	p 277	A92-55764	#
ETN-92-91194	p 43	N92-23168	#	ETN-92-91890	p 58	N92-30418	#	IAF PAPER 92-0359	p 277	A92-55766	#
ETN-92-91197	p 270	N92-22241	#	ETN-92-91901	p 220	N92-30423	#	IAF PAPER 92-0368	p 277	A92-55773	#
ETN-92-91203	p 125	N92-20715	#	ETN-92-91902	p 87	N92-30424	#	IAF PAPER 92-0383	p 128	A92-57370	#
ETN-92-91207	p 48	N92-29159	#	ETN-92-91903	p 5	N92-30232	#	IAF PAPER 92-0466	p 274	A92-55806	#
ETN-92-91208	p 133	N92-23780	#	ETN-92-91905	p 204	N92-30674	#	IAF PAPER 92-0502	p 121	A92-55827	#
ETN-92-91214	p 158	N92-25378	#	ETN-92-91906	p 5	N92-30675	#	IAF PAPER 92-0534	p 121	A92-55842	#
ETN-92-91262	p 99	N92-24336	#	ETN-92-91907	p 50	N92-30676	#	IAF PAPER 92-0546	p 125	A92-55850	#
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ETN-92-91296	p 160	N92-25307	#	ETN-92-91959	p 204	N92-32725	#	IAF PAPER 92-0780	p 122	A92-57189	#
ETN-92-91301	p 84	N92-24966	#	ETN-92-91963	p 205	N92-33996	#	IAF PAPER 92-0816	p 133	A92-57214	#
ETN-92-91319	p 50	N92-31508	#	ETN-92-91965	p 211	N92-34152	#	IAF PAPER 92-0867	p 127	A92-57258	#
ETN-92-91325	p 48	N92-29206	#	ETN-92-91994	p 51	N92-32730	#	IAF PAPER 92-0873	p 127	A92-57262	#
ETN-92-91326	p 202	N92-28788	#	ETN-92-91996	p 221	N92-33139	#	IAF PAPER 92-0878	p 128	A92-57266	#
ETN-92-91327	p 48	N92-28789	#	ETN-92-91997	p 51	N92-32732	#	IAF PAPER 92-0884	p 125	A92-57272	#
ETN-92-91328	p 249	N92-28844	#	ETN-92-91998	p 118	N92-32734	#	IAF PAPER 92-0934	p 151	A92-57307	#
ETN-92-91342	p 202	N92-29683	#	ETN-92-91999	p 109	N92-32750	#	IAF PAPER 92-0970	p 133	A92-57328	#
ETN-92-91348	p 243	N92-29213	#	ETN-92-92000	p 51	N92-32673	#	IAF PAPER 92-1023	p 282	A92-57345	#
ETN-92-91352	p 225	N92-29688	#	ETN-92-92001	p 66	N92-32830	#				
ETN-92-91355	p 138	N92-25828	#	ETN-92-92005	p 139	N92-32834	#	IB-222-90-A-46	p 191	N92-18244	#
ETN-92-91380	p 135	N92-24432	#	ETN-92-92006	p 205	N92-32835	#	IC-90/265	p 273	N92-70166	#
ETN-92-91381	p 127	N92-23750	#	ETN-92-92053	p 288	N92-33694	#	IC-91/177	p 284	N92-22653	#
ETN-92-91382	p 158	N92-25668	#	ETN-92-92054	p 249	N92-33908	#	IHES/M/91/81	p 271	N92-21788	#
ETN-92-91385	p 217	N92-29878	#	ETN-92-92056	p 205	N92-33910	#	ILR-MITT-263(1991)	p 62	N92-10997	#
ETN-92-91387	p 148	N92-31942	#	ETN-92-92082	p 52	N92-32800	#	INFORME-I-522/90	p 145	N92-10068	#
ETN-92-91388	p 122	N92-29879	#	ETN-92-92088	p 204	N92-32765	#	INT-PATENT-CLASS-B05B-1/00	p 205	N92-32856	#
ETN-92-91389	p 233	N92-26329	#	ETN-92-92102	p 204	N92-32767	#	IOS-289-1991	p 243	N92-29213	#
ETN-92-91390	p 92	N92-29870	#	ETN-92-92103	p 205	N92-33916	#				
ETN-92-91391	p 287	N92-29218	#	ETN-92-92104	p 102	N92-33645	#				
ETN-92-91392	p 287	N92-29219	#	ETN-92-92118	p 154	N92-32742	#				
ETN-92-91401	p 117	N92-28579	#	ETN-92-92123	p 150	N92-32895	#				
ETN-92-91403	p 261	N92-28581	#	ETN-92-92163	p 109	N92-34161	#				
ETN-92-91431	p 261	N92-28648	#	ETN-92-92183	p 102	N92-33748	#				
ETN-92-91432	p 86	N92-28649	#	ETN-92-92185	p 88	N92-33750	#				
ETN-92-91433	p 220	N92-28650	#	ETN-92-92186	p 230	N92-33751	#	ISBN 0-471-92351-6	p 166	A92-22624	#
ETN-92-91434	p 87	N92-28651	#	ETN-92-92599	p 283	N92-27049	#	ISBN 0-471-92794-5	p 120	A92-33401	#
ETN-92-91435	p 109	N92-28652	#	ETN-92-99978	p 76	N92-14042	#	ISBN 0-521-36264-4	p 69	A92-33919	#
ETN-92-91436	p 109	N92-28653	#					ISBN 0-85498-530-1	p 144	A92-45335	#
ETN-92-91437	p 92	N92-28654	#	F+W-TF-2058	p 85	N92-26944	#	ISBN 0-903409-68-2	p 3	A92-45302	#
ETN-92-91439	p 57	N92-28655	#					ISBN 0-903409-78-X	p 54	A92-39301	#
ETN-92-91440	p 57	N92-29703	#	FEL-91-A162	p 158	N92-25378	#	ISBN 1-56081-122-6	p 274	A92-52701	#
ETN-92-91446	p 87	N92-28687	#					ISBN 2-85428-288-4	p 131	A92-27130	#
ETN-92-91447	p 86	N92-28634	#	FFA-TN-1990-19	p 41	N92-20468	#	ISBN 3-540-53137-8	p 169	A92-29649	#
ETN-92-91448	p 264	N92-28635	#	FFA-TN-1990-20	p 50	N92-30713	#	ISBN 90-6275-608-5	p 68	A92-26550	#
ETN-92-91449	p 220	N92-29603	#	FFA-TN-1990-43	p 268	N92-12599	#	ISBN 91-7848-224-0	p 266	A92-39042	#
ETN-92-91450	p 47	N92-28657	#	FFA-TN-1991-22	p 76	N92-11993	#				
ETN-92-91453	p 264	N92-29604	#	FFA-TN-1991-24	p 219	N92-12313	#	ISBN-0-85679-766-9	p 28	N92-11967	#
ETN-92-91454	p 66	N92-29605	#	FFA-TN-1991-30	p 268	N92-12601	#	ISBN-0-85679-769-3	p 28	N92-11968	#
ETN-92-91489	p 202	N92-29926	#	FFA-TN-1991-40	p 43	N92-23168	#	ISBN-0-85679-771-5	p 28	N92-11969	#
ETN-92-91491	p 49	N92-29741	#					ISBN-0-85679-776-6	p 28	N92-11970	#
ETN-92-91492	p 49	N92-29889	#	FFI-91/7007-VOL-3	p 156	N92-12157	#	ISBN-0-85679-778-2	p 77	N92-15987	#
ETN-92-91495	p 129	N92-29680	#	FFI-91/7009	p 242	N92-12386	#	ISBN-0-85679-779-0	p 77	N92-18096	#
ETN-92-91496	p 128	N92-29629	#					ISBN-0-85679-782-0	p 77	N92-17847	#
ETN-92-91497	p 48	N92-29648	#	GAO/NSIAD-90-71FS	p 113	N92-13076	#	ISBN-0-85679-783-9	p 39	N92-15970	#
ETN-92-91498	p 49	N92-29713	#					ISBN-0-85679-791-X	p 39	N92-15973	#
ETN-92-91499	p 48	N92-29649	#	GARTEUR-TP-051	p 87	N92-29616	#	ISBN-0-85679-793-6	p 77	N92-15988	#
ETN-92-91500	p 87	N92-29650	#					ISBN-0-85679-794-4	p 39	N92-15971	#
ETN-92-91512	p 47	N92-28658	#	GARTEUR/TP-056	p 109	N92-28652	#	ISBN-0-85679-795-2	p 269	N92-18074	#
ETN-92-91513	p 66	N92-29615	#					ISBN-0-85679-804-5	p 84	N92-24009	#
ETN-92-91514	p 87	N92-29616	#	GMD-550	p 260	N92-16645	#	ISBN-0-85679-805-3	p 240	N92-17853	#
ETN-92-91517	p 225	N92-29707	#					ISBN-0-85679-807-X	p 51	N92-32782	#
ETN-92-91518	p 47	N92-28659	#	IAEA-TECDOC-628/S	p 217	N92-23258	#	ISBN-0-85679-811-8	p 109	N92-32780	#
ETN-92-91519	p 47	N92-28660	#					ISBN-0-85679-829-0	p 50	N92-32479	#
ETN-92-91521	p 220	N92-28643	#	IAF PAPER ST-92-0002	p 282	A92-57353	#	ISBN-0-904947-15-7	p 52	N92-70499	#
ETN-92-91523	p 234	N92-28689	#	IAF PAPER ST-92-0017	p 27	A92-57363	#	ISBN-0-904947-16-5	p 52	N92-70514	#
ETN-92-91525	p 58	N92-30474	#	IAF PAPER ST-92-0022	p 254	A92-57366	#	ISBN-0-904947-17-3	p 52	N92-70513	#
ETN-92-91530	p 47	N92-28709	#					ISBN-0-904947-34-3	p 5	N92-12988	#
ETN-92-91533	p 202	N92-28712	#	IAF PAPER 90-653	p 245	A92-12125	#	ISBN-0309-7293	p 195	N92-22209	#
ETN-92-91535	p 47	N92-28692	#	IAF PAPER 91-002	p 251	A92-12427	#	ISBN-0379-6566	p 158	N92-25668	#
ETN-92-91536	p 117	N92-28661	#	IAF PAPER 91-008	p 118	A92-12433	#	ISBN-1-871564-32-8	p 192	N92-19916	#
ETN-92-91537	p 117	N92-29204	#	IAF PAPER 91-059	p 129	A92-12473	#	ISBN-1-871564-33-6	p 40	N92-19679	#
ETN-92-91538	p 220	N92-28850	#	IAF PAPER 91-105	p 119	A92-12508	#	ISBN-1-871564-35-2	p 265	N92-19924	#
ETN-92-91540	p 201	N92-28694	#	IAF PAPER 91-186	p 126	A92-12560	#	ISBN-1-871564-360	p 88	N92-31515	#
ETN-92-91547	p 49	N92-29884	#	IAF PAPER 91-207	p 126	A92-14705	#	ISBN-1-871564-387	p 50	N92-31514	#
ETN-92-91610	p 230	N92-29499	#	IAF PAPER 91-217	p 125	A92-14708	#	ISBN-100-05-1131	p 287	N92-19411	#
ETN-92-91613	p 146	N92-30414	#	IAF PAPER 91-288	p 130	A92-14714	#	ISBN-2-7170-0945-0	p 112	N92-11020	#
ETN-92-91664	p 51	N92-32769	#	IAF PAPER 91-305	p 130	A92-14722	#	ISBN-2-7170-0961-2	p 185	N92-11288	#
ETN-92-91665	p 204	N92-32770	#	IAF PAPER 91-345	p 130	A92-14751	#	ISBN-82-7542-009-1	p 153	N92-19521	#
ETN-92-91671	p 51	N92-32773	#	IAF PAPER 91-473	p 131	A92-18494	#	ISBN-90-54-11001-5	p 230	N92-29499	#
ETN-92-91675	p 204	N92-32776	#	IAF PAPER 91-495	p 155	A92-18509	#	ISBN-90-5411-010-4	p 225	N92-30230	#
ETN-92-91696	p 5	N92-29874	#	IAF PAPER 91-509	p 129	A92-18519	#	ISBN-90-6275-734-0	p 259	N92-25306	#
ETN-92-91704	p 50	N92-30713	#	IAF PAPER 91-550	p 246	A92-18547	#	ISBN-92-63-10752-1	p 240	N92-18911	#
ETN-92-91705	p 287	N92-30996	#	IAF PAPER 91-639	p 278	A92-20591	#	ISBN-92-835-0575-1	p 275	N92-17198	#
ETN-92-91709	p 49	N92-30514	#	IAF PAPER 91-719	p 119	A92-20644	#	ISBN-92-835-0623-5	p 30	N92-12996	#
ETN-92-91711	p 58	N92-31943	#	IAF PAPER 92-0018	p 124	A92-55516	#	ISBN-92-835-0628-6	p 261	N92-12517	#
ETN-92-91727	p 50	N92-31514	#	IAF PAPER 92-0031	p 132	A92-55527	#	ISBN-92-835-0631-6	p 244	N92-13547	#
ETN-92-91728	p 88	N92-31515	#	IAF PAPER 92-0042	p 127	A92-55537	#	ISBN-92-835-0632-4	p 75	N92-11001	#
ETN-92-91731	p 158	N92-29877	#	IAF PAPER 92-0177	p 279	A92-55635	#	ISBN-92-835-0634-0	p 286	N92-13916	#
ETN-92-91732	p 58	N92-31813	#	IAF PAPER 92-0178	p 282	A92-55636	#	ISBN-92-835-0636-7	p 91	N92-14046	#
ETN-92-91733	p 270	N92-29997	#	IAF PAPER 92-0186	p 286	A92-55641	#	ISBN-92-835-0637-5	p 41	N92-20797	#
ETN-92-91756	p 202	N92-29972	#	IAF PAPER 92-0249	p 244	A92-55688	#	ISBN-92-835-0638-3	p 247	N92-18972	#
ETN-92-91761	p 202	N92-29977	#	IAF PAPER 92-0327	p 128	A92-55748	#	ISBN-92-835-0639-1	p 277	N92-18659	#
ETN-92-91818	p 203	N92-30453	#	IAF PAPER 92-0343	p 277	A92-55758	#	ISBN-92-835-0641-3	p 81	N	

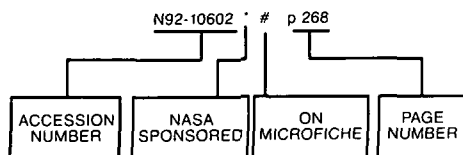
ISBN-92-835-0645-6	p 252	N92-19008	#	MPE-PREPRINT-175	p 283	N92-27049	ONERA-RS-97/5094-PY	p 269	N92-21736	#
ISBN-92-835-0650-2	p 108	N92-20026	#	MPIS-100/1991	p 209	N92-17344	ONERA-RSF-128/1865-AY-726A	p 115	N92-20385	#
ISBN-92-835-0651-O	p 275	N92-17212	#	MPIS-4/1991	p 193	N92-20180	ONERA-RSF-136/1865-AY-728-A	p 48	N92-28789	#
ISBN-92-835-0652-9	p 83	N92-23950	#	MPIS-98/1990	p 40	N92-17314	ONERA-RSF-24/1408-AY-150A	p 51	N92-32773	#
ISBN-92-835-0653-7	p 83	N92-23227	#	MPIS-99/1990	p 40	N92-17315	ONERA-RSF-43/1736-AY-146A	p 202	N92-28788	#
ISBN-92-835-0657-X	p 92	N92-28376	#	NAS 1.26:190353	p 43	N92-25959 *	ONERA-RSF-44/1147-AY-144A	p 185	N92-11308	#
ISBN-92-835-0658-8	p 92	N92-32437	#	NAS 1.26:190822	p 221	N92-33139 *	ONERA-RSF-77/3617-AY-022A	p 48	N92-29206	#
ISBN-92-835-0659-6	p 198	N92-27450	#	NASA-CR-190353	p 43	N92-25959 *	ONERA-RSF-82/1685-AY-154-4	p 41	N92-19682	#
ISBN-92-835-0660-X	p 44	N92-27936	#	NASA-CR-190822	p 221	N92-33139 *	ONERA-RT-16/3641-PY	p 269	N92-20387	#
ISBN-92-835-0661-8	p 44	N92-27706	#	NLR-MP-88031-U	p 47	N92-28658	ONERA-RT-44/1621-RY-016-R	p 204	N92-32776	#
ISBN-92-835-0662-6	p 5	N92-27887	#	NLR-MP-88032-U	p 118	N92-70563	ONERA-RT-47/1147-AY-146A-PT-3p	52	N92-32800	#
ISBN-92-835-0665-0	p 85	N92-27870	#	NLR-MP-88040-U	p 66	N92-29615	ONERA-RT-56/3064-RY-006-R	p 28	N92-10989	#
ISBN-92-835-0666-9	p 146	N92-33033	#	NLR-MP-88044-U	p 87	N92-29616	ONERA-RTS-11/3446-EY	p 249	N92-28844	#
ISBN-92-835-0668-5	p 85	N92-28468	#	NLR-TP-89003-U	p 206	N92-70561	ONERA-RTS-21/4365-AY-056A	p 76	N92-11009	#
ISBN-92-835-0669-3	p 118	N92-30769	#	NLR-TP-89004-U	p 118	N92-70574	ONERA-RTS-86/1685-AY-156A	p 186	N92-11310	#
ISBN-92-835-0670-7	p 50	N92-30947	#	NLR-TP-89016-U	p 88	N92-70575	ONERA, TP NO. 1991-110	p 163	A92-16089	#
ISBN-92-835-0671-5	p 200	N92-28571	#	NLR-TP-89021-U	p 150	N92-70307	ONERA, TP NO. 1991-114	p 9	A92-16093	#
ISBN-92-835-0674-X	p 101	N92-28458	#	NLR-TP-89030-U	p 213	N92-16313	ONERA, TP NO. 1991-124	p 9	A92-16102	#
ISBN-92-835-0675-8	p 85	N92-28469	#	NLR-TP-89103-U	p 225	N92-29707	ONERA, TP NO. 1991-131	p 9	A92-16107	#
ISBN-92-835-0678-2	p 264	N92-32229	#	NLR-TP-89115-U	p 88	N92-70581	ONERA, TP NO. 1991-132	p 226	A92-16108	#
ISBN-92-9092-083-1	p 152	N92-19413	#	NLR-TP-89119-U	p 47	N92-28659	ONERA, TP NO. 1991-135	p 110	A92-16110	#
ISBN-92-9092-106-4	p 152	N92-18607	#	NLR-TP-89126-U	p 47	N92-28660	ONERA, TP NO. 1991-140	p 163	A92-16114	#
ISBN-92-9092-114-5	p 33	N92-14973	#	NLR-TP-89150-U-PT-1	p 53	N92-70590	ONERA, TP NO. 1991-152	p 9	A92-16122	#
ISBN-92-9092-126-9	p 133	N92-23780	#	NLR-TP-89163-U	p 220	N92-28643	ONERA, TP NO. 1991-155	p 206	A92-16124	#
ISBN-92-9092-134-X	p 135	N92-24432	#	NLR-TP-89179-U	p 53	N92-70576	ONERA, TP NO. 1991-157	p 9	A92-16125	#
ISBN-92-9092-138-2	p 138	N92-25828	#	NLR-TP-89182-U	p 115	N92-18416	ONERA, TP NO. 1991-158	p 131	A92-16126	#
ISBN-92-9092-140-4	p 122	N92-29879	#	NLR-TP-89217-U	p 234	N92-28689	ONERA, TP NO. 1991-161	p 110	A92-16128	#
ISBN-92-9092-146-3	p 122	N92-24719	#	NLR-TP-89272-U	p 53	N92-70577	ONERA, TP NO. 1991-162	p 9	A92-16129	#
ISBN-92-9092-150-1	p 127	N92-23750	#	NLR-TP-89279-U	p 118	N92-70983	ONERA, TP NO. 1991-166	p 10	A92-16133	#
ISBN-92-9092-154-4	p 158	N92-25668	#	NLR-TP-89284-U	p 58	N92-30474	ONERA, TP NO. 1991-170	p 110	A92-16135	#
ISBN-92-9092-210-9	p 125	N92-20715	#	NLR-TP-89343-U	p 52	N92-70540	ONERA, TP NO. 1991-174	p 265	A92-16138	#
ISBN-92-9092-222-2	p 134	N92-23967	#	NLR-TP-89365-U	p 41	N92-20473	ONERA, TP NO. 1991-177	p 10	A92-16139	#
ISBN-951-22-0389-8	p 42	N92-21784	#	NLR-TP-90028-U	p 261	N92-28648	ONERA, TP NO. 1991-178	p 10	A92-16140	#
ISBN-951-22-0525-4	p 263	N92-24963	#	NLR-TP-90029-U	p 41	N92-20498	ONERA, TP NO. 1991-187	p 10	A92-16141	#
ISBN-951-22-0607-2	p 269	N92-21773	#	NLR-TP-90060-L	p 187	N92-14325	ONERA, TP NO. 1991-192	p 266	A92-26353	#
ISBN-951-22-0648-X	p 194	N92-21763	#	NLR-TP-90062-U	p 47	N92-28709	ONERA, TP NO. 1991-196	p 255	A92-26355	#
ISBN-951-22-0649-8	p 195	N92-22788	#	NLR-TP-90068-U	p 86	N92-28649	ONERA, TP NO. 1991-197	p 13	A92-26356	#
ISBN-951-22-0763-X	p 43	N92-22233	#	NLR-TP-90070-U	p 220	N92-28650	ONERA, TP NO. 1991-198	p 13	A92-26357	#
ISBN-951-22-0903-9	p 259	N92-25519	#	NLR-TP-90084-U	p 77	N92-15065	ONERA, TP NO. 1991-202	p 54	A92-26359	#
ISBN-951-42-2903-7	p 282	N92-25758	#	NLR-TP-90087-U	p 108	N92-20475	ONERA, TP NO. 1991-203	p 111	A92-26360	#
ISSN-0939-298X	p 58	N92-31813	#	NLR-TP-90099-L	p 188	N92-14326	ONERA, TP NO. 1991-204	p 54	A92-26361	#
ISVR-TR-194	p 270	N92-22241	#	NLR-TP-90108-U	p 87	N92-28651	ONERA, TP NO. 1991-211	p 266	A92-26363	#
LR-623	p 187	N92-14325	#	NLR-TP-90129-U	p 109	N92-28652	ONERA, TP NO. 1991-212	p 13	A92-26364	#
LR-624	p 188	N92-14326	#	NLR-TP-90134-U	p 202	N92-28712	ONERA, TP NO. 1991-215	p 260	A92-26368	#
LR-646	p 33	N92-14004	#	NLR-TP-90144-U	p 47	N92-28692	ONERA, TP NO. 1991-218	p 13	A92-26370	#
LR-655	p 77	N92-14045	#	NLR-TP-90145-U	p 117	N92-28661	ONERA, TP NO. 1991-219	p 111	A92-26371	#
LR-662	p 117	N92-28579	#	NLR-TP-90147-U	p 117	N92-29204	ONERA, TP NO. 1991-224	p 94	A92-26376	#
LR-665	p 261	N92-28581	#	NLR-TP-90159-U	p 109	N92-28653	ONERA, TP NO. 1991-229	p 13	A92-26381	#
MBB-FE-2-S-PUB-472	p 87	N92-29650	#	NLR-TP-90163-U	p 92	N92-28654	ONERA, TP NO. 1991-235	p 168	A92-26386	#
MBB-FE-202-S-PUB-0462-A	p 129	N92-29680	#	NLR-TP-90172-U	p 220	N92-28850	ONERA, TP NO. 1991-237	p 13	A92-26387	#
MBB-FE-202-S-PUB-0463-A	p 128	N92-29629	#	NLR-TP-90184-U	p 201	N92-28694	ONERA, TP NO. 1991-94	p 206	A92-16077	#
MBB-FE-202-S-PUB-0464-A	p 48	N92-29648	#	NLR-TP-90192-U	p 57	N92-28655	ONERA, TP NO. 1991-96	p 103	A92-16079	#
MBB-FE-202-S-PUB-0468-A	p 49	N92-29713	#	NLR-TP-90196-U	p 57	N92-29703	ONERA, TP NO. 1991-98	p 235	A92-16080	#
MBB-FE-202-S-PUB-0469-A	p 48	N92-29649	#	NLR-TP-90305-U	p 87	N92-28687	ONERA, TP NO. 1992-109	p 127	A92-55537	#
MBB-FE-211/S/PUB/0465/A	p 40	N92-19296	#	NLR-TP-90307-U	p 86	N92-28634	ONERA, TP NO. 1992-199	p 268	A92-56169	#
MBB-FE-211/S/PUB/458/O	p 194	N92-21704	#	NLR-TP-90334-U	p 264	N92-28635	ONERA, TP NO. 1992-1	p 23	A92-48577	#
MBB-FE2-PUB-S-450	p 78	N92-18333	#	NLR-TP-90336-U	p 220	N92-29603	ONERA, TP NO. 1992-202	p 159	A92-54678	#
MBB-FE202-S-PUB-0453-A	p 145	N92-17310	#	NLR-TP-90368-U	p 47	N92-28657	ONERA, TP NO. 1992-22	p 24	A92-48585	#
MBB-FE211-S-PUB-446	p 39	N92-17311	#	NLR-TP-91046-U	p 51	N92-32730	ONERA, TP NO. 1992-23	p 73	A92-48586	#
MBB-FE211-S-PUB-447	p 190	N92-17312	#	NLR-TP-91052-U	p 221	N92-33139 *	ONERA, TP NO. 1992-25	p 4	A92-48587	#
MBB-FE211-S-PUB-449	p 42	N92-22179	#	NLR-TP-91061-U	p 264	N92-29604	ONERA, TP NO. 1992-27	p 73	A92-48589	#
MBB-FE211-S-PUB-452	p 77	N92-17313	#	NLR-TP-91062-U-PT-1	p 66	N92-29605	ONERA, TP NO. 1992-2	p 149	A92-48578	#
MBB-UD-0593-91-PUB	p 219	N92-14382	#	NLR-TP-91117-U	p 51	N92-32732	ONERA, TP NO. 1992-30	p 171	A92-31488	#
MBB-UD-0606-91-PUB	p 5	N92-29874	#	NLR-TP-91119-U	p 118	N92-32734	ONERA, TP NO. 1992-31	p 218	A92-48592	#
MBB-UD-0611-91-PUB	p 58	N92-30418	#	NLR-TP-91134-U	p 109	N92-32750	ONERA, TP NO. 1992-33	p 267	A92-48594	#
MBB-UH-HE512	p 224	N92-23392	#	NLR-TP-91154-U	p 51	N92-32673	ONERA, TP NO. 1992-34	p 267	A92-48595	#
MBB-UK-0140-PUB	p 275	N92-18634	#	NLR-TP-91156-U	p 66	N92-32830	ONERA, TP NO. 1992-35	p 267	A92-48596	#
MBB-UK-0141-91-PUB	p 215	N92-17544	#	NLR-TP-91219-U	p 139	N92-32834	ONERA, TP NO. 1992-39	p 111	A92-48600	#
MBB-UK-0143-PUB	p 216	N92-18632	#	NLR-TP-91250-U	p 205	N92-32835	ONERA, TP NO. 1992-40	p 267	A92-48601	#
MBB-UK-0144-PUB	p 142	N92-18636	#	NLR-TR-87180-U	p 67	N92-70564	ONERA, TP NO. 1992-43	p 180	A92-48604	#
MBB-UK-0155-89-PUB	p 42	N92-21703	#	NLR-TR-88071-U	p 52	N92-70249	ONERA, TP NO. 1992-46	p 207	A92-48607	#
MBB-Z-0359-90-PUB	p 282	N92-15938	#	NLR-TR-88072-U	p 49	N92-29884	ONERA, TP NO. 1992-47	p 105	A92-48608	#
MBB-Z-0371-91-PUB	p 62	N92-10996	#	NLR-TR-88081-U	p 192	N92-18323	ONERA, TP NO. 1992-49	p 149	A92-48610	#
MBB-Z-0399-91-PUB	p 154	N92-32742	#	NLR-TR-88108-U	p 64	N92-19491	ONERA, TP NO. 1992-50	p 144	A92-48611	#
MBB-Z-0406-91-PUB	p 150	N92-32895	#	NLR-TR-88154-U	p 191	N92-18221	ONERA, TP NO. 1992-52	p 218	A92-48613	#
MBB/FE202/S/PUB/461	p 5	N92-30232	#	NLRGC/B-1-4/91	p 249	N92-33908	ONERA, TP NO. 1992-55	p 181	A92-48616	#
MBB/FE211/S/PUB/466	p 204	N92-30674	#	NPS-OC-91-002	p 243	N92-28365	ONERA, TP NO. 1992-72	p 20	A92-45487	#
MBB/FE211/S/PUB/474	p 5	N92-30675	#	NSC-REPT(91)-8	p 153	N92-19521	ONERA, TP NO. 1992-7	p 24	A92-48579	#
MBB/FE213/S/PUB/459	p 50	N92-30676	#	NTSB/AAR-91/06	p 56	N92-21873	OTN-021385	p 219	N92-14382	#
MBB/FW321/S/PUB/467	p 220	N92-30423	#	ONERA-NT-1989-8	p 148	N92-31942	OTN-033124	p 62	N92-10996	#
MBB/FW321/S/PUB/476	p 87	N92-30424	#	ONERA-NT-1990-8	p 49	N92-30514	OTN-033148	p 275	N92-18634	#
MEMO-1009	p 202	N92-29972	#	ONERA-NT-1991-5	p 284	N92-20477	OTN-033151	p 216	N92-18632	#
MEMO-1015	p 202	N92-29977	#	ONERA-NT-1991-9	p 193	N92-19932	OTN-033152	p 142	N92-18636	#
MEMO-997	p 196	N92-23251	#	ONERA-RF-31/3409-PY	p 29	N92-11972	PB91-212068	p 228	N92-13494	#
							PB91-218842	p 187	N92-14321	#
							PB91-219444	p 52	N92-70249	#
							PB91-219477	p 150	N92-70307	#
							PB91-222190	p 213	N92-16313	#

REPORT NUMBER INDEX

WMO-752

PB91-232868	p 260	N92-16645	#	SAE PAPER 912111	p 89	A92-39963
PB91-910406	p 56	N92-21873	#	SAE PAPER 912192	p 72	A92-40009
PB92-133172	p 187	N92-14325	#	SAE PAPER 912225	p 54	A92-40023
PB92-133180	p 33	N92-14004	#			
PB92-133198	p 188	N92-14326	#	SER-B-90-B27	p 42	N92-21784
PB92-133438	p 77	N92-14045	#	SER-B-91-B33	p 43	N92-22233
PB92-134147	p 269	N92-21773	#	SER-B-91-B34	p 259	N92-25519
PB92-134162	p 194	N92-21763	#			
PB92-134170	p 195	N92-22788	#	SESSIA-430/91.960	p 50	N92-31508
PB92-134402	p 271	N92-21788	#	SESSIA-430/91-940	p 29	N92-11979
PB92-136431	p 43	N92-22233	#			
PB92-136449	p 42	N92-21784	#	TD91-2229	p 158	N92-25378
PB92-138502	p 67	N92-70564	#			
PB92-138510	p 118	N92-70563	#	TKK-F-A629	p 206	N92-70151
PB92-138569	p 206	N92-70561	#	TKK-F-A668	p 273	N92-22738
PB92-138577	p 118	N92-70574	#	TKK-F-A673	p 197	N92-26507
PB92-138619	p 88	N92-70575	#	TKK-F-A684	p 269	N92-21773
PB92-138643	p 77	N92-15065	#	TKK-F-A688	p 195	N92-22788
PB92-138650	p 88	N92-70591	#	TKK-F-A691	p 265	N92-23665
PB92-138676	p 53	N92-70590	#			
PB92-138692	p 53	N92-70576	#	TT-8903-PT-1	p 52	N92-70499
PB92-138718	p 53	N92-70577	#	TT-8904	p 52	N92-70514
PB92-138726	p 118	N92-70983	#	TT-8905	p 52	N92-70513
PB92-138759	p 52	N92-70540	#	TT-9107	p 5	N92-12988
PB92-142231	p 197	N92-26507	#			
PB92-142256	p 265	N92-23665	#	TUM-M9105	p 204	N92-32767
PB92-142298	p 263	N92-24963	#			
PB92-142421	p 273	N92-22738	#	VKI-LS-1991-06	p 99	N92-24336
PB92-148758	p 196	N92-23251	#	VKI-LS-1991-07	p 189	N92-16226
PB92-151919	p 259	N92-25519	#	VKI-LS-1992-01-VOL-2	p 109	N92-34161
PB92-180678	p 203	N92-30023	#			
				VKI-TN-176	p 188	N92-14328
PNR-90768	p 98	N92-21740	#	VKI-TN-178	p 269	N92-21237
PNR-90773	p 194	N92-21742	#			
PNR-90776	p 228	N92-21743	#	WMO-752	p 240	N92-18911
PNR-90777	p 145	N92-21744	#			
PNR-90781	p 276	N92-20927	#			
PNR-90782	p 228	N92-20928	#			
PNR-90789	p 99	N92-22098	#			
PNR-90791	p 194	N92-22099	#			
PNR-90798	p 220	N92-20909	#			
PNR-90802	p 100	N92-27422	#			
PNR-90805	p 99	N92-27039	#			
PNR-90806	p 115	N92-22096	#			
PNR-90808	p 100	N92-27040	#			
PNR-90809	p 100	N92-27041	#			
PNR-90814	p 98	N92-19938	#			
PNR-90821	p 258	N92-21847	#			
PNR-90824	p 99	N92-21848	#			
PNR-90832	p 99	N92-21850	#			
PNR-90833	p 279	N92-21851	#			
PNR-90839	p 98	N92-20573	#			
PNR-90840	p 275	N92-20458	#			
PNR-90844	p 98	N92-20459	#			
PNR-90846	p 269	N92-20461	#			
PNR-90847	p 228	N92-20574	#			
PNR-90848	p 98	N92-19939	#			
PNR-90853	p 149	N92-20911	#			
PNR-90862	p 98	N92-20179	#			
PNR-90872	p 102	N92-33748	#			
PNR-90875	p 88	N92-33750	#			
PNR-90876	p 230	N92-33751	#			
PREPRINT-1365	p 187	N92-12219	#			
R/D-5824-AN-01	p 96	N92-11015	#			
R/D-5824-AN-01	p 101	N92-28073	#			
R/D-5824-AN-01	p 214	N92-33538	#			
R/D-6662-AN-01	p 192	N92-18934	#			
R/D-6662-AN-02	p 192	N92-18933	#			
R/D-6750-MS-01	p 150	N92-29647	#			
RAE-TM-FS(F)-632-REV-ISSUE-1	p 55	N92-14007	#			
RAE-TM-FS-1009	p 107	N92-12004	#			
RAE-TM-P-1205	p 187	N92-14319	#			
RAE-TM-P-1216	p 100	N92-27062	#			
RAE-2029/236	p 195	N92-22209	#			
RC-90-08	p 29	N92-11978	#			
REPT-117(1990)	p 282	N92-25758	#			
REPT-11	p 263	N92-24963	#			
REPT-3/1990	p 282	N92-15938	#			
REPT-68	p 203	N92-30023	#			
REPT-90/30	p 113	N92-12006	#			
REPT-90/55	p 187	N92-12216	#			
REPT-90/59	p 29	N92-11982	#			
REPT-91-12	p 187	N92-14321	#			
REPT-91-68	p 203	N92-30453	#			
REPT-91-70	p 203	N92-30372	#			
REPT-91-73	p 203	N92-30454	#			
REPT-911-430-134	p 152	N92-12146	#			
REPT-911-430-136	p 145	N92-12065	#			

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A92-10036	p 161	A92-13815	p 6	A92-19964	p 164	A92-24945	p 59
A92-10037	p 161	A92-13816	p 6	A92-19967	p 164	A92-24946	p 59
A92-10232	p 143	A92-13837	p 250	A92-20083	p 143	A92-25026	p 149
A92-10629	p 230	A92-13849	p 250	A92-20131	p 159	A92-25074	p 68
A92-10654	p 161	A92-13851	p 58	A92-20134	p 68	A92-25075	p 53
A92-10658	p 161	A92-13852	p 59	A92-20136	p 68	A92-25096	p 12
A92-10666	p 67	A92-13855	p 235	A92-20203	p 68	A92-25098	p 12
A92-10689	p 161	A92-13865	p 283	A92-20212	p 10	A92-25178	p 1
A92-10695	p 211	A92-13977	p 235	A92-20218	p 11	A92-25180	p 2
A92-11131	p 251	A92-14020	p 147	A92-20344	p 147	A92-25181	p 54
A92-11135	p 251	A92-14052	p 235	A92-20345	p 264	A92-25198	p 236
A92-11173	p 249	A92-14147	p 283	A92-20393	p 150	A92-25475	p 147
A92-11215	p 279	A92-14171	p 285	A92-20511	p 164	A92-25520	p 59
A92-11219	p 162	A92-14348	p 1	A92-20515	p 279	A92-25521	p 54
A92-11225	p 162	A92-14398	p 67	A92-20516	p 278	A92-25575	p 2
A92-11268	p 234	A92-14416	p 67	A92-20591	p 278	A92-25615	p 150
A92-11348	p 130	A92-14424	p 7	A92-20644	p 119	A92-25655	p 60
A92-11561	p 103	A92-14447	p 1	A92-20724	p 164	A92-25735	# p 12
A92-11595	p 103	A92-14705	p 126	A92-20737	p 11	A92-25770	# p 12
A92-11815	p 211	A92-14708	p 125	A92-20810	p 284	A92-26128	p 149
A92-11830	p 217	A92-14714	p 130	A92-20996	p 206	A92-26220	p 167
A92-11877	p 58	A92-14722	p 130	A92-21014	p 1	A92-26221	p 167
A92-11881	p 118	A92-14751	p 130	A92-21125	p 110	A92-26269	* # p 168
A92-11882	p 67	A92-15202	p 148	A92-21196	p 236	A92-26353	p 266
A92-11897	p 273	A92-15222	p 217	A92-21216	p 218	A92-26355	p 255
A92-12125	p 245	A92-15244	p 148	A92-21288	p 129	A92-26356	p 13
A92-12278	p 241	A92-15282	p 148	A92-21306	p 164	A92-26357	p 13
A92-12290	p 155	A92-15303	p 143	A92-21318	p 11	A92-26359	p 54
A92-12291	p 155	A92-15345	p 7	A92-21450	p 206	A92-26360	p 111
A92-12293	p 155	A92-15384	p 130	A92-21461	p 165	A92-26361	p 54
A92-12299	p 155	A92-15409	p 131	A92-21504	p 11	A92-26363	p 266
A92-12345	p 265	A92-15410	p 131	A92-21505	p 165	A92-26364	p 13
A92-12346	p 217	A92-15483	p 162	A92-21506	p 165	A92-26367	p 168
A92-12347	p 110	A92-15501	p 211	A92-21613	p 165	A92-26368	p 260
A92-12427	p 251	A92-15533	p 7	A92-21700	p 1	A92-26370	p 13
A92-12433	p 118	A92-15535	p 7	A92-21703	p 165	A92-26371	p 111
A92-12473	p 129	A92-15536	p 7	A92-21922	p 111	A92-26376	p 94
A92-12508	p 119	A92-15549	p 7	A92-21923	p 165	A92-26381	p 13
A92-12560	p 126	A92-15565	p 8	A92-21976	p 11	A92-26386	p 168
A92-12649	p 6	A92-15569	p 8	A92-22000	p 88	A92-26387	p 13
A92-13015	p 249	A92-15571	p 8	A92-22124	p 165	A92-26409	p 168
A92-13019	p 249	A92-15603	p 8	A92-22137	# p 94	A92-26550	p 68
A92-13020	p 249	A92-15613	p 8	A92-22149	# p 11	A92-26793	p 2
A92-13027	p 250	A92-15624	p 214	A92-22185	# p 255	A92-26849	p 69
A92-13198	p 6	A92-15625	p 93	A92-22186	# p 256	A92-26967	# p 168
A92-13199	p 103	A92-15636	p 93	A92-22346	p 165	A92-27034	# p 261
A92-13233	p 6	A92-15657	p 162	A92-22446	p 11	A92-27130	p 131
A92-13235	p 6	A92-15661	p 214	A92-22473	p 68	A92-27131	p 285
A92-13336	p 234	A92-15667	p 162	A92-22474	p 68	A92-27150	p 218
A92-13448	p 6	A92-15689	p 8	A92-22475	p 166	A92-27231	p 221
A92-13540	p 217	A92-15690	* p 8	A92-22607	p 236	A92-27379	p 168
A92-13671	p 162	A92-15718	p 9	A92-22624	p 166	A92-27384	p 14
A92-13675	p 110	A92-15720	p 93	A92-22725	p 278	A92-27385	p 168
A92-13699	p 88	A92-15722	p 162	A92-22760	p 148	A92-27396	p 284
A92-13700	p 53	A92-15808	p 122	A92-22773	p 210	A92-27475	p 168
		A92-15818	p 123	A92-22785	p 211	A92-27737	p 262
				A92-22794	# p 1	A92-27796	p 236
				A92-22891	p 272	A92-27800	p 236
				A92-18001	p 68	A92-28005	p 14
				A92-18002	p 143	A92-28006	p 14
				A92-18100	p 110	A92-28061	p 169
				A92-18494	p 131	A92-28133	p 132
				A92-18509	p 155	A92-28184	p 2
				A92-18519	p 129	A92-28523	* p 14
				A92-18547	p 246	A92-28941	p 2
				A92-18593	p 283	A92-28942	p 169
				A92-18606	p 123	A92-28950	p 169
				A92-18680	p 10	A92-28975	p 14
				A92-18771	p 10	A92-28990	p 169
				A92-18902	p 235	A92-29094	p 103
				A92-18937	p 88	A92-29392	p 272
				A92-19124	p 261	A92-29523	p 169
				A92-19193	p 226	A92-29599	# p 169
				A92-19382	p 255	A92-29649	p 169
				A92-19395	p 255	A92-29704	p 132
				A92-19404	p 255	A92-29973	p 94
				A92-19405	p 255	A92-29998	p 170
				A92-19406	p 255	A92-30000	p 14
				A92-19677	p 217	A92-30091	p 69
				A92-19697	p 218	A92-30092	p 2
				A92-19767	p 148	A92-30101	p 286
				A92-19796	p 148	A92-30108	p 286
				A92-19819	p 68	A92-30456	p 285

A92-30638

A92-30638 p 230
 A92-31164 p 170
 A92-31188 p 15
 A92-31196 p 170
 A92-31271 p 231
 A92-31275 p 231
 A92-31399 p 170
 A92-31451 p 170
 A92-31460 p 170
 A92-31461 p 170
 A92-31488 p 171
 A92-31496 p 15
 A92-31665 # p 171
 A92-31683 # p 94
 A92-31691 # p 69
 A92-31709 # p 140
 A92-32080 p 89
 A92-32228 p 171
 A92-32240 p 171
 A92-32323 p 15
 A92-32325 p 69
 A92-32451 p 119
 A92-32465 p 119
 A92-32466 p 119
 A92-32467 p 120
 A92-32469 p 120
 A92-32487 p 237
 A92-32489 p 237
 A92-32490 p 237
 A92-32491 p 237
 A92-33048 p 280
 A92-33195 # p 127
 A92-33257 # p 274
 A92-33286 # p 123
 A92-33326 # p 69
 A92-33344 # p 69
 A92-33363 # p 212
 A92-33401 p 120
 A92-33403 p 120
 A92-33404 p 123
 A92-33409 p 123
 A92-33410 p 132
 A92-33413 p 132
 A92-33417 p 132
 A92-33427 p 60
 A92-33430 p 2
 A92-33438 p 60
 A92-33466 p 171
 A92-33574 p 272
 A92-33919 p 69
 A92-34193 p 244
 A92-34257 p 246
 A92-34542 # p 256
 A92-34650 p 69
 A92-34878 p 242
 A92-34903 p 221
 A92-34943 p 242
 A92-34949 p 242
 A92-34980 p 155
 A92-35007 p 222
 A92-35025 p 242
 A92-35034 p 222
 A92-35173 p 222
 A92-35256 p 89
 A92-35302 p 222
 A92-35434 p 70
 A92-35474 p 279
 A92-35475 p 144
 A92-35587 p 280
 A92-35588 p 280
 A92-35589 p 280
 A92-35591 p 280
 A92-35592 p 280
 A92-35593 p 280
 A92-35594 p 280
 A92-35595 p 280
 A92-35734 p 70
 A92-35738 p 70
 A92-35742 p 89
 A92-35750 p 70
 A92-35752 p 70
 A92-35763 p 89
 A92-35765 p 89
 A92-35767 p 70
 A92-35769 p 104
 A92-35771 p 70
 A92-35774 p 71
 A92-35780 p 71
 A92-35928 p 60
 A92-35937 p 71
 A92-35940 p 71
 A92-35941 p 89
 A92-36021 p 15
 A92-36029 p 15
 A92-36073 p 120
 A92-36126 p 94

A92-36192 p 171
 A92-36292 p 150
 A92-36347 p 172
 A92-36350 p 2
 A92-36682 p 281
 A92-36695 p 281
 A92-36830 p 15
 A92-36839 p 15
 A92-36889 p 94
 A92-36990 p 104
 A92-37072 p 60
 A92-37073 p 60
 A92-37074 p 71
 A92-37154 p 222
 A92-37159 p 206
 A92-37388 p 172
 A92-37504 p 172
 A92-37535 p 172
 A92-37539 p 16
 A92-37551 p 16
 A92-37553 p 16
 A92-37554 p 16
 A92-37573 p 172
 A92-37633 p 222
 A92-37789 p 262
 A92-37874 p 71
 A92-37875 p 3
 A92-37905 p 231
 A92-37932 p 172
 A92-37933 p 16
 A92-37936 p 172
 A92-38088 p 214
 A92-38374 p 54
 A92-38375 p 54
 A92-38382 p 250
 A92-38383 p 237
 A92-38384 p 61
 A92-38401 p 262
 A92-38793 p 281
 A92-38858 p 16
 A92-38861 p 17
 A92-38868 p 172
 A92-38897 p 173
 A92-38971 p 159
 A92-39042 p 266
 A92-39044 p 226
 A92-39046 p 226
 A92-39050 p 226
 A92-39052 p 226
 A92-39053 p 227
 A92-39054 p 227
 A92-39055 p 227
 A92-39057 p 227
 A92-39058 p 227
 A92-39060 p 266
 A92-39064 p 227
 A92-39065 p 227
 A92-39082 p 71
 A92-39084 p 72
 A92-39085 p 266
 A92-39086 p 266
 A92-39087 p 72
 A92-39089 p 72
 A92-39109 p 267
 A92-39180 p 246
 A92-39214 p 246
 A92-39301 p 54
 A92-39303 p 54
 A92-39304 p 72
 A92-39308 p 152
 A92-39309 p 95
 A92-39310 p 54
 A92-39427 p 17
 A92-39433 p 17
 A92-39471 p 237
 A92-39510 p 120
 A92-39514 p 111
 A92-39908 p 104
 A92-39940 p 17
 A92-39963 p 89
 A92-40009 p 72
 A92-40023 p 54
 A92-40030 p 72
 A92-40035 p 72
 A92-40039 p 104
 A92-40054 p 173
 A92-40055 p 17
 A92-40081 p 17
 A92-40083 p 173
 A92-40088 p 173
 A92-40089 p 173
 A92-40097 p 173
 A92-40102 p 173
 A92-40107 p 174
 A92-40123 p 174
 A92-40125 p 18

A92-40127 p 18
 A92-40128 p 18
 A92-40129 p 174
 A92-40131 p 174
 A92-40140 p 18
 A92-40143 p 18
 A92-40144 p 95
 A92-40156 p 174
 A92-40158 p 174
 A92-40161 p 175
 A92-40170 p 175
 A92-40172 p 175
 A92-40239 p 61
 A92-40401 p 226
 A92-40438 p 251
 A92-40455 p 140
 A92-40547 p 132
 A92-40548 p 95
 A92-40549 p 18
 A92-40600 p 18
 A92-40880 p 3
 A92-41177 p 3
 A92-41289 p 19
 A92-41545 p 19
 A92-41655 p 175
 A92-41656 p 175
 A92-41764 p 123
 A92-41800 p 231
 A92-41814 p 175
 A92-41817 p 19
 A92-41819 p 95
 A92-41820 p 286
 A92-41823 p 3
 A92-41875 p 175
 A92-42093 p 228
 A92-42124 p 19
 A92-42141 p 144
 A92-42142 p 212
 A92-42145 p 212
 A92-42300 p 176
 A92-42315 p 155
 A92-42500 p 55
 A92-42529 p 176
 A92-42534 p 176
 A92-42535 p 176
 A92-43045 p 176
 A92-43055 p 19
 A92-43068 p 176
 A92-43071 p 19
 A92-43167 p 19
 A92-43262 p 123
 A92-43391 p 124
 A92-43446 p 55
 A92-43447 p 19
 A92-43548 p 281
 A92-43549 p 281
 A92-43550 p 281
 A92-43596 p 128
 A92-43617 p 176
 A92-43881 p 61
 A92-44167 p 223
 A92-44197 p 267
 A92-44327 p 207
 A92-44352 p 177
 A92-44395 p 177
 A92-44801 p 177
 A92-44895 p 3
 A92-44926 p 250
 A92-44994 p 277
 A92-44998 p 55
 A92-45012 p 246
 A92-45021 p 247
 A92-45030 p 251
 A92-45047 p 251
 A92-45065 p 250
 A92-45089 p 177
 A92-45091 p 177
 A92-45093 p 177
 A92-45094 p 178
 A92-45095 p 178
 A92-45129 p 207
 A92-45136 p 207
 A92-45302 p 3
 A92-45306 p 95
 A92-45311 p 72
 A92-45314 p 111
 A92-45315 p 73
 A92-45317 p 95
 A92-45318 p 20
 A92-45319 p 104
 A92-45321 p 95
 A92-45322 p 104
 A92-45323 p 111
 A92-45324 p 20
 A92-45335 p 144

A92-45336 p 144
 A92-45337 p 144
 A92-45373 p 61
 A92-45477 # p 20
 A92-45487 # p 20
 A92-45491 # p 73
 A92-45492 # p 256
 A92-45507 # p 20
 A92-45523 # p 20
 A92-45546 # p 21
 A92-45558 # p 21
 A92-45565 # p 21
 A92-45569 # p 21
 A92-45603 p 178
 A92-45704 p 178
 A92-45827 p 21
 A92-45839 p 21
 A92-46243 p 90
 A92-46247 p 90
 A92-46254 p 178
 A92-46260 p 178
 A92-46261 p 178
 A92-46265 p 179
 A92-46429 p 96
 A92-46441 p 22
 A92-46442 p 179
 A92-46448 p 3
 A92-46449 p 90
 A92-46468 p 120
 A92-46765 p 104
 A92-46806 p 73
 A92-46825 p 179
 A92-46900 p 22
 A92-46918 p 179
 A92-46948 p 22
 A92-46954 # p 22
 A92-46958 p 22
 A92-46982 # p 273
 A92-47038 p 22
 A92-47041 p 22
 A92-47047 p 262
 A92-47053 p 262
 A92-47056 p 179
 A92-47061 p 22
 A92-47070 p 179
 A92-47075 p 262
 A92-47078 p 263
 A92-47079 p 23
 A92-47081 p 263
 A92-47084 p 256
 A92-47089 p 263
 A92-47090 p 23
 A92-47146 p 284
 A92-47157 p 179
 A92-47345 p 237
 A92-47422 p 265
 A92-47592 p 3
 A92-47676 p 180
 A92-47733 p 238
 A92-47734 p 238
 A92-47774 p 3
 A92-47777 p 105
 A92-47779 p 105
 A92-47782 p 23
 A92-47783 p 105
 A92-47784 p 105
 A92-47785 p 105
 A92-47791 p 96
 A92-47821 p 4
 A92-47876 # p 23
 A92-47899 # p 180
 A92-47921 p 265
 A92-47958 p 149
 A92-47969 p 73
 A92-47974 p 275
 A92-47975 p 73
 A92-48200 p 180
 A92-48203 p 180
 A92-48206 p 180
 A92-48207 p 23
 A92-48254 p 180
 A92-48308 p 61
 A92-48468 p 61
 A92-48477 p 90
 A92-48478 p 129
 A92-48496 p 105
 A92-48577 p 23
 A92-48578 p 149
 A92-48579 p 24
 A92-48585 p 24
 A92-48586 p 73
 A92-48587 p 4
 A92-48589 p 73
 A92-48592 p 218
 A92-48594 p 267
 A92-48595 p 267

A92-48596 p 267
 A92-48600 p 111
 A92-48601 p 267
 A92-48604 p 180
 A92-48607 p 207
 A92-48608 p 105
 A92-48610 p 149
 A92-48611 p 144
 A92-48613 p 218
 A92-48616 p 181
 A92-48619 p 181
 A92-48701 # p 24
 A92-48702 # p 24
 A92-48910 # p 260
 A92-49016 # p 181
 A92-49017 # p 147
 A92-49046 # p 132
 A92-49115 # p 96
 A92-49258 p 139
 A92-49302 p 256
 A92-49326 p 106
 A92-49445 p 263
 A92-49454 p 281
 A92-49511 p 181
 A92-49515 p 24
 A92-49516 p 181
 A92-49771 p 238
 A92-49773 p 207
 A92-50007 p 144
 A92-50008 p 106
 A92-50009 p 73
 A92-50037 p 207
 A92-50086 p 181
 A92-50108 p 181
 A92-50121 p 24
 A92-50122 p 61
 A92-50162 p 247
 A92-50292 p 247
 A92-50297 p 182
 A92-50477 p 182
 A92-50503 p 106
 A92-50779 p 212
 A92-51228 p 210
 A92-51563 p 145
 A92-51580 p 74
 A92-51630 p 207
 A92-51745 p 218
 A92-51781 p 238
 A92-51783 p 239
 A92-51784 p 239
 A92-51808 p 4
 A92-51854 p 281
 A92-51856 p 282
 A92-51870 p 282
 A92-51891 p 182
 A92-51892 p 182
 A92-51893 p 182
 A92-51947 p 74
 A92-51950 p 215
 A92-52028 p 24
 A92-52034 p 24
 A92-52080 # p 124
 A92-52211 p 273
 A92-52300 p 74
 A92-52354 p 239
 A92-52370 p 208
 A92-52395 p 247
 A92-52404 p 182
 A92-52594 p 239
 A92-52682 p 25
 A92-52701 p 274
 A92-52702 p 274
 A92-52722 p 182
 A92-52724 p 182
 A92-52734 p 25
 A92-52738 p 124
 A92-52739 p 274
 A92-52748 p 25
 A92-52753 p 25
 A92-52755 p 25
 A92-52764 p 25
 A92-52770 p 25
 A92-52771 p 256
 A92-52782 p 274
 A92-52785 p 182
 A92-52794 p 183
 A92-52799 p 141
 A92-52814 p 183
 A92-52847 p 267
 A92-52848 p 26
 A92-52849 p 74
 A92-52876 p 231
 A92-52941 p 239
 A92-52965 p 272
 A92-52973 p 26
 A92-52982 p 145

ACCESSION NUMBER INDEX

ACCESSION NUMBER INDEX

N92-19048

A92-52983	p 149	A92-56307	p 75	N92-12206	p 186	N92-14541 *	p 232	N92-18221	# p 191
A92-53052	p 183	A92-56308	p 106	N92-12210	# p 186	N92-14631	# p 257	N92-18231	# p 40
A92-53078	p 26	A92-56327	p 4	N92-12211	# p 186	N92-14973	# p 33	N92-18232	# p 40
A92-53079	p 26	A92-56330	p 75	N92-12215	# p 186	N92-14974	# p 34	N92-18234	# p 243
A92-53080 *	p 26	A92-56331	p 27	N92-12216	# p 187	N92-14976	# p 188	N92-18235	# p 191
A92-53120	p 96	A92-56332	p 27	N92-12219	# p 187	N92-14977	# p 133	N92-18236	# p 191
A92-53121	p 74	A92-56334	p 107	N92-12313	# p 219	N92-14978	# p 34	N92-18244	# p 191
A92-53124	p 183	A92-56340	p 75	N92-12386	# p 242	N92-14980	# p 133	N92-18291	# p 191
A92-53236	p 55	A92-56342	p 75	N92-12451	# p 256	N92-14981	# p 34	N92-18294	# p 107
A92-53239	p 62	A92-56343	p 75	N92-12452	# p 257	N92-14985	# p 34	N92-18317	# p 191
A92-53250	p 4	A92-56344 *	p 268	N92-12456	# p 129	N92-14986	# p 34	N92-18318	# p 40
A92-53253	p 26	A92-56350	p 75	N92-12457	# p 257	N92-14987	# p 34	N92-18319	# p 192
A92-53349	p 239	A92-56351	p 27	N92-12461	# p 257	N92-14988	# p 35	N92-18320	# p 192
A92-53412	p 139	A92-56352	p 27	N92-12462	# p 257	N92-14989	# p 35	N92-18321	# p 107
A92-53415	p 140	A92-56703	p 247	N92-12465	# p 257	N92-14990	# p 35	N92-18322	# p 5
A92-53430	p 121	A92-56773	# p 112	N92-12467	# p 257	N92-14991	# p 35	N92-18323	# p 192
A92-53452	p 121	A92-56784	# p 112	N92-12468	# p 257	N92-14992	# p 35	N92-18333	# p 78
A92-53453	p 121	A92-56798	# p 112	N92-12517	# p 261	N92-14994	# p 35	N92-18340	# p 243
A92-53457	p 121	A92-56809	# p 75	N92-12532	# p 90	N92-14995	# p 36	N92-18341	# p 114
A92-53458	p 121	A92-56826	# p 209	N92-12533	# p 252	N92-14996	# p 36	N92-18416	# p 115
A92-53459	p 121	A92-56849	# p 141	N92-12536	# p 5	N92-14997	# p 36	N92-18479	# p 151
A92-53645	p 124	A92-56866	p 219	N92-12544	# p 261	N92-14998	# p 36	N92-18573	# p 220
A92-53731	p 62	A92-56944	p 247	N92-12559	# p 268	N92-14999	# p 113	N92-18574	# p 78
A92-53774	p 121	A92-57061	p 141	N92-12601	# p 268	N92-15000	# p 36	N92-18577	# p 145
A92-53777	p 279	A92-57090	p 141	N92-12988	# p 5	N92-15001	# p 114	N92-18579	# p 78
A92-54208	# p 141	A92-57189	p 122	N92-12996	# p 30	N92-15002	# p 114	N92-18580	# p 78
A92-54302	p 208	A92-57214	p 133	N92-12997	# p 30	N92-15003	# p 114	N92-18582	# p 78
A92-54303	p 208	A92-57258	p 127	N92-12998	# p 30	N92-15004	# p 209	N92-18583	# p 78
A92-54304	p 208	A92-57262	p 127	N92-12999	# p 30	N92-15005	# p 36	N92-18584	# p 79
A92-54308	p 26	A92-57266	p 128	N92-13000	# p 30	N92-15006	# p 37	N92-18585	# p 79
A92-54321	p 208	A92-57272	p 125	N92-13001	# p 30	N92-15007	# p 37	N92-18586	# p 79
A92-54322	p 112	A92-57307	p 151	N92-13003	# p 31	N92-15008	# p 37	N92-18591	# p 79
A92-54323	p 112	A92-57328	p 133	N92-13005	# p 31	N92-15009	# p 114	N92-18592	# p 79
A92-54324	p 90	A92-57345	p 262	N92-13008	# p 31	N92-15012	# p 114	N92-18593	# p 79
A92-54336	p 112	A92-57353	p 282	N92-13010	# p 31	N92-15013	# p 269	N92-18607	# p 152
A92-54337	p 208	A92-57363	p 27	N92-13011	# p 31	N92-15014	# p 37	N92-18608	# p 215
A92-54339	p 209	A92-57366	p 254	N92-13012	# p 31	N92-15015	# p 37	N92-18618	# p 152
A92-54484	p 267	A92-57370	p 128	N92-13013	# p 32	N92-15017	# p 37	N92-18619	# p 275
A92-54487	p 183	A92-57399	p 219	N92-13014	# p 32	N92-15018	# p 37	N92-18623	# p 257
A92-54488	p 183	A92-57449	p 185	N92-13015	# p 32	N92-15019	# p 38	N92-18624	# p 153
A92-54545	p 74			N92-13018	# p 32	N92-15023	# p 38	N92-18629	# p 215
A92-54546	p 96	N92-10068	# p 145	N92-13021	# p 32	N92-15025	# p 38	N92-18630	# p 160
A92-54574	p 263	N92-10114	# p 156	N92-13022	# p 32	N92-15026	# p 188	N92-18632	# p 216
A92-54645 *	p 231	N92-10163	# p 185	N92-13027	# p 33	N92-15027	# p 188	N92-18633	# p 216
A92-54678	p 159	N92-10164	# p 185	N92-13028	# p 33	N92-15029	# p 188	N92-18634	# p 275
A92-54862	p 215	N92-10476	# p 271	N92-13029	# p 33	N92-15030	# p 189	N92-18635	# p 153
A92-54867	p 212	N92-10479	# p 271	N92-13076	# p 113	N92-15031	# p 38	N92-18636	# p 142
A92-54870	p 213	N92-10501	# p 273	N92-13155	# p 141	N92-15032	# p 38	N92-18637	# p 153
A92-54963	p 183	N92-10534	# p 209	N92-13174	# p 141	N92-15033	# p 189	N92-18639	# p 216
A92-54971	p 184	N92-10563	# p 140	N92-13176	# p 142	N92-15035	# p 38	N92-18640	# p 275
A92-55089	p 232	N92-10565	# p 140	N92-13236	# p 142	N92-15040	# p 38	N92-18645	# p 216
A92-55172	# p 106	N92-10602 *	p 268	N92-13494	# p 228	N92-15041	# p 39	N92-18647	# p 258
A92-55182	# p 260	N92-10605 *	p 268	N92-13512	# p 232	N92-15042	# p 39	N92-18648	# p 216
A92-55216	# p 124	N92-10988	# p 28	N92-13547	# p 244	N92-15045	# p 39	N92-18649	# p 153
A92-55332	# p 106	N92-10989	# p 28	N92-13548	# p 250	N92-15056	# p 77	N92-18650	# p 153
A92-55369	# p 27	N92-10996	# p 62	N92-13550	# p 250	N92-15072	# p 107	N92-18651	# p 216
A92-55401	# p 124	N92-10997	# p 62	N92-13555	# p 251	N92-15232	# p 156	N92-18655	# p 153
A92-55403	p 213	N92-11001	# p 75	N92-13556	# p 251	N92-15272	# p 156	N92-18659	# p 277
A92-55441	p 232	N92-11009	# p 76	N92-13916	# p 286	N92-15284	# p 157	N92-18661	# p 278
A92-55477	p 184	N92-11012	# p 96	N92-13929 *	# p 76	N92-15285	# p 157	N92-18665	# p 278
A92-55479	p 184	N92-11015	# p 96	N92-13938 *	# p 97	N92-15298	# p 282	N92-18728	# p 97
A92-55516	p 124	N92-11020	# p 112	N92-13940 *	# p 97	N92-15961	# p 286	N92-18778	# p 80
A92-55527	p 132	N92-11069	# p 133	N92-13943 *	# p 97	N92-15970	# p 39	N92-18779	# p 80
A92-55537	p 127	N92-11222	# p 156	N92-13948 *	# p 76	N92-15971	# p 39	N92-18781	# p 80
A92-55635	p 279	N92-11288	# p 185	N92-13949 *	# p 76	N92-15973	# p 39	N92-18782	# p 80
A92-55636	p 282	N92-11306	# p 185	N92-13951 *	# p 33	N92-15987	# p 77	N92-18786	# p 80
A92-55641	p 286	N92-11307	# p 185	N92-13952 *	# p 97	N92-15988	# p 77	N92-18787	# p 80
A92-55688	p 244	N92-11308	# p 185	N92-13956 *	# p 97	N92-16227	# p 189	N92-18789	# p 81
A92-55748	p 128	N92-11310	# p 186	N92-14004	# p 33	N92-16231	# p 189	N92-18790	# p 81
A92-55758	p 277	N92-11404	# p 223	N92-14007	# p 55	N92-16234	# p 189	N92-18793	# p 107
A92-55761	p 277	N92-11412	# p 223	N92-14018	# p 62	N92-16235	# p 190	N92-18794	# p 81
A92-55762	p 277	N92-11471	# p 223	N92-14027	# p 113	N92-16236	# p 190	N92-18795	# p 108
A92-55764	p 277	N92-11506	# p 223	N92-14042	# p 76	N92-16237	# p 190	N92-18911	# p 240
A92-55766	p 277	N92-11535	# p 223	N92-14045	# p 77	N92-16238	# p 190	N92-18933	# p 192
A92-55773	p 277	N92-11963	# p 286	N92-14046	# p 91	N92-16313	# p 213	N92-18934	# p 192
A92-55806	p 274	N92-11967	p 28	N92-14050	# p 91	N92-16645	# p 260	N92-18972	# p 247
A92-55827	p 121	N92-11968	p 28	N92-14051	# p 91	N92-17169	# p 242	N92-18978	# p 248
A92-55842	p 121	N92-11969	p 28	N92-14052	# p 91	N92-17198	# p 275	N92-18984	# p 248
A92-55850	p 125	N92-11970	p 28	N92-14054	# p 91	N92-17212	# p 275	N92-18991	# p 248
A92-56123	p 184	N92-11972	# p 29	N92-14057	# p 92	N92-17310	# p 145	N92-18994	# p 252
A92-56124	p 184	N92-11973	# p 29	N92-14141	# p 147	N92-17311	# p 39	N92-18996	# p 252
A92-56125	p 184	N92-11978	# p 29	N92-14268	# p 156	N92-17312	# p 190	N92-18999	# p 252
A92-56155	p 55	N92-11979	# p 29	N92-14303	# p 187	N92-17313	# p 77	N92-19000	# p 252
A92-56169	p 268	N92-11980	# p 29	N92-14304	# p 187	N92-17314	# p 40	N92-19005	# p 216
A92-56277	p 4	N92-11981	# p 29	N92-14319	# p 187	N92-17315	# p 40	N92-19008	# p 252
A92-56278	p 264	N92-11982	# p 29	N92-14321	# p 187	N92-17344	# p 209	N92-19009	# p 253
A92-56281	p 96	N92-11993	# p 76	N92-14325	# p 187	N92-17434	# p 211	N92-19013	# p 253
A92-56283	p 106	N92-12004	# p 107	N92-14326	# p 188	N92-17544	# p 215	N92-19019	# p 253
A92-56285	p 74	N92-12005	# p 113	N92-14328	# p 188	N92-17847	# p 77	N92-19041	# p 62
A92-56287	p 74	N92-12006	# p 113	N92-14360	# p 213	N92-17853	# p 240	N92-19042	# p 62
A92-56291	p 90	N92-12065	# p 145	N92-14382	# p 219	N92-17928	# p 286	N92-19043	# p 63
A92-56292	p 90	N92-12146	# p 152	N92-14397	# p 219	N92-17974	# p 190	N92-19044	# p 63
A92-56299	p 4	N92-12156	# p 156	N92-14420	# p 219	N92-18074	# p 269	N92-19045	# p 63
A92-56302	p 74	N92-12157	# p 156	N92-14428	# p 219	N92-18088	# p 190	N92-19046	# p 63
A92-56304	p 4	N92-12184	# p 160	N92-14431	# p 215	N92-18089	# p 243	N92-19047	# p 63
A92-56306	p 4	N92-12203	p 186	N92-14498	p 232	N92-18096	p 77	N92-19048	# p 63

N92-19049

N92-19049 # p 63
 N92-19050 # p 64
 N92-19108 # p 216
 N92-19151 # p 157
 N92-19155 # p 157
 N92-19164 # p 157
 N92-19292 # p 232
 N92-19294 # p 192
 N92-19295 # p 108
 N92-19296 # p 40
 N92-19349 # p 192
 N92-19411 # p 287
 N92-19413 # p 152
 N92-19491 # p 64
 N92-19521 # p 153
 N92-19621 # p 108
 N92-19679 # p 40
 N92-19682 # p 41
 N92-19701 # p 81
 N92-19916 # p 192
 N92-19924 # p 265
 N92-19925 # p 41
 N92-19926 # p 253
 N92-19932 # p 193
 N92-19938 # p 98
 N92-19939 # p 98
 N92-20026 # p 108
 N92-20179 # p 98
 N92-20180 # p 193
 N92-20230 # p 193
 N92-20232 # p 193
 N92-20249 # p 129
 N92-20317 # p 193
 N92-20385 # p 115
 N92-20387 # p 269
 N92-20458 # p 275
 N92-20459 # p 98
 N92-20461 # p 269
 N92-20468 # p 41
 N92-20473 # p 41
 N92-20475 # p 108
 N92-20477 # p 284
 N92-20498 # p 41
 N92-20573 # p 98
 N92-20574 # p 228
 N92-20590 # p 258
 N92-20600 # p 258
 N92-20601 # p 261
 N92-20610 # p 258
 N92-20611 # p 64
 N92-20615 # p 258
 N92-20621 # p 276
 N92-20626 # p 258
 N92-20715 # p 125
 N92-20720 # p 126
 N92-20726 # p 126
 N92-20774 # p 126
 N92-20778 # p 126
 N92-20786 # p 126
 N92-20794 # p 55
 N92-20795 # p 81
 N92-20797 # p 41
 N92-20902 # p 64
 N92-20909 # p 220
 N92-20911 # p 149
 N92-20927 # p 276
 N92-20928 # p 228
 N92-21232 # p 194
 N92-21234 # p 194
 N92-21237 # p 269
 N92-21416 # p 145
 N92-21635 # p 273
 N92-21679 # p 55
 N92-21680 # p 55
 N92-21683 # p 56
 N92-21689 # p 56
 N92-21692 # p 56
 N92-21693 # p 56
 N92-21697 # p 56
 N92-21703 # p 42
 N92-21704 # p 194
 N92-21736 # p 269
 N92-21740 # p 98
 N92-21742 # p 194
 N92-21743 # p 228
 N92-21744 # p 145
 N92-21746 # p 56
 N92-21763 # p 194
 N92-21773 # p 269
 N92-21784 # p 42
 N92-21788 # p 271
 N92-21847 # p 258
 N92-21848 # p 99
 N92-21850 # p 99
 N92-21851 # p 279
 N92-21873 # p 56

N92-21951 # p 81
 N92-21955 # p 194
 N92-21958 # p 64
 N92-21959 # p 64
 N92-21960 # p 65
 N92-21964 # p 82
 N92-21966 # p 82
 N92-21970 # p 82
 N92-21971 # p 82
 N92-21973 # p 82
 N92-21993 # p 213
 N92-22000 # p 82
 N92-22096 # p 115
 N92-22098 # p 99
 N92-22099 # p 194
 N92-22100 # p 195
 N92-22121 # p 195
 N92-22179 # p 42
 N92-22180 # p 42
 N92-22181 # p 42
 N92-22182 # p 42
 N92-22183 # p 42
 N92-22193 # p 43
 N92-22200 # p 195
 N92-22209 # p 195
 N92-22233 # p 43
 N92-22241 # p 270
 N92-22269 # p 142
 N92-22270 # p 142
 N92-22271 # p 142
 N92-22275 # p 143
 N92-22406 # p 99
 N92-22653 # p 84
 N92-22738 # p 273
 N92-22788 # p 195
 N92-23071 # p 248
 N92-23120 # p 195
 N92-23149 # p 195
 N92-23168 # p 43
 N92-23227 # p 83
 N92-23232 # p 83
 N92-23233 # p 83
 N92-23236 # p 83
 N92-23238 # p 108
 N92-23239 # p 83
 N92-23251 # p 196
 N92-23258 # p 217
 N92-23295 # p 271
 N92-23381 # p 224
 N92-23383 # p 224
 N92-23389 # p 224
 N92-23392 # p 224
 N92-23393 # p 224
 N92-23402 # p 224
 N92-23403 # p 224
 N92-23407 # p 224
 N92-23665 # p 265
 N92-23750 # p 127
 N92-23780 # p 133
 N92-23786 # p 134
 N92-23797 # p 127
 N92-23821 # p 134
 N92-23825 # p 134
 N92-23836 # p 134
 N92-23843 # p 196
 N92-23844 # p 196
 N92-23846 # p 196
 N92-23925 # p 224
 N92-23929 # p 276
 N92-23950 # p 83
 N92-23951 # p 84
 N92-23952 # p 84
 N92-23954 # p 84
 N92-23955 # p 84
 N92-23967 # p 134
 N92-23973 # p 125
 N92-23974 # p 134
 N92-23975 # p 285
 N92-24009 # p 84
 N92-24073 # p 157
 N92-24095 # p 158
 N92-24098 # p 158
 N92-24167 # p 158
 N92-24336 # p 99
 N92-24341 # p 196
 N92-24342 # p 196
 N92-24343 # p 196
 N92-24351 # p 287
 N92-24363 # p 209
 N92-24387 # p 135
 N92-24389 # p 135
 N92-24392 # p 197
 N92-24394 # p 43
 N92-24395 # p 43
 N92-24411 # p 259
 N92-24432 # p 135

N92-24433 # p 135
 N92-24443 # p 135
 N92-24445 # p 135
 N92-24451 # p 136
 N92-24454 # p 136
 N92-24458 # p 140
 N92-24467 # p 136
 N92-24471 # p 136
 N92-24474 # p 136
 N92-24487 # p 259
 N92-24493 # p 136
 N92-24494 # p 137
 N92-24495 # p 137
 N92-24496 # p 137
 N92-24499 # p 137
 N92-24504 # p 137
 N92-24510 # p 137
 N92-24515 # p 197
 N92-24594 # p 122
 N92-24617 # p 152
 N92-24642 # p 285
 N92-24645 # p 43
 N92-24659 # p 233
 N92-24719 # p 122
 N92-24721 # p 137
 N92-24724 # p 138
 N92-24728 # p 138
 N92-24755 # p 138
 N92-24774 # p 125
 N92-24777 # p 122
 N92-24829 # p 151
 N92-24963 # p 263
 N92-24966 # p 84
 N92-25073 # p 213
 N92-25238 # p 228
 N92-25242 # p 229
 N92-25243 # p 229
 N92-25245 # p 229
 N92-25306 # p 259
 N92-25307 # p 160
 N92-25378 # p 158
 N92-25413 # p 287
 N92-25519 # p 259
 N92-25590 # p 65
 N92-25591 # p 84
 N92-25592 # p 92
 N92-25594 # p 85
 N92-25595 # p 65
 N92-25596 # p 85
 N92-25597 # p 65
 N92-25600 # p 65
 N92-25601 # p 65
 N92-25602 # p 209
 N92-25603 # p 92
 N92-25666 # p 154
 N92-25668 # p 158
 N92-25679 # p 285
 N92-25758 # p 282
 N92-25761 # p 283
 N92-25762 # p 283
 N92-25782 # p 283
 N92-25785 # p 276
 N92-25786 # p 275
 N92-25787 # p 278
 N92-25828 # p 138
 N92-25834 # p 138
 N92-25841 # p 253
 N92-25842 # p 253
 N92-25848 # p 259
 N92-25850 # p 154
 N92-25851 # p 154
 N92-25852 # p 160
 N92-25853 # p 154
 N92-25859 # p 139
 N92-25875 # p 154
 N92-25881 # p 139
 N92-25892 # p 253
 N92-25897 # p 197
 N92-25959 # p 43
 N92-26086 # p 287
 N92-26295 # p 233
 N92-26301 # p 233
 N92-26310 # p 233
 N92-26315 # p 233
 N92-26318 # p 233
 N92-26329 # p 233
 N92-26331 # p 233
 N92-26335 # p 240
 N92-26336 # p 234
 N92-26337 # p 225
 N92-26340 # p 234
 N92-26342 # p 234
 N92-26348 # p 240
 N92-26349 # p 57
 N92-26473 # p 229

N92-26507 # p 197
 N92-26599 # p 197
 N92-26944 # p 85
 N92-26974 # p 160
 N92-26977 # p 244
 N92-26986 # p 154
 N92-27007 # p 254
 N92-27008 # p 122
 N92-27010 # p 254
 N92-27013 # p 127
 N92-27023 # p 254
 N92-27026 # p 254
 N92-27027 # p 197
 N92-27039 # p 99
 N92-27040 # p 100
 N92-27041 # p 100
 N92-27049 # p 283
 N92-27062 # p 100
 N92-27108 # p 272
 N92-27118 # p 160
 N92-27126 # p 244
 N92-27148 # p 143
 N92-27231 # p 271
 N92-27284 # p 272
 N92-27300 # p 151
 N92-27304 # p 213
 N92-27422 # p 100
 N92-27450 # p 198
 N92-27451 # p 198
 N92-27452 # p 198
 N92-27454 # p 198
 N92-27457 # p 198
 N92-27460 # p 198
 N92-27462 # p 100
 N92-27463 # p 100
 N92-27464 # p 101
 N92-27466 # p 101
 N92-27469 # p 101
 N92-27470 # p 199
 N92-27471 # p 199
 N92-27472 # p 199
 N92-27475 # p 199
 N92-27476 # p 199
 N92-27479 # p 199
 N92-27480 # p 199
 N92-27481 # p 200
 N92-27482 # p 200
 N92-27483 # p 200
 N92-27484 # p 101
 N92-27486 # p 147
 N92-27487 # p 200
 N92-27490 # p 200
 N92-27671 # p 200
 N92-27672 # p 200
 N92-27675 # p 201
 N92-27676 # p 201
 N92-27678 # p 201
 N92-27680 # p 201
 N92-27706 # p 44
 N92-27707 # p 44
 N92-27708 # p 44
 N92-27711 # p 44
 N92-27714 # p 44
 N92-27743 # p 214
 N92-27789 # p 161
 N92-27804 # p 115
 N92-27870 # p 85
 N92-27887 # p 5
 N92-27888 # p 264
 N92-27895 # p 66
 N92-27897 # p 66
 N92-27902 # p 128
 N92-27903 # p 259
 N92-27905 # p 66
 N92-27936 # p 44
 N92-27940 # p 44
 N92-27942 # p 45
 N92-27943 # p 45
 N92-27944 # p 45
 N92-27945 # p 45
 N92-27946 # p 45
 N92-27947 # p 45
 N92-27948 # p 46
 N92-27949 # p 46
 N92-27950 # p 46
 N92-27952 # p 46
 N92-27954 # p 46
 N92-27958 # p 108
 N92-27962 # p 46
 N92-28062 # p 201
 N92-28073 # p 101
 N92-28365 # p 243
 N92-28376 # p 92
 N92-28379 # p 92
 N92-28458 # p 101
 N92-28460 # p 102

N92-28461 # p 102
 N92-28464 # p 102
 N92-28465 # p 102
 N92-28468 # p 85
 N92-28469 # p 85
 N92-28470 # p 86
 N92-28471 # p 86
 N92-28472 # p 86
 N92-28474 # p 86
 N92-28523 # p 115
 N92-28526 # p 115
 N92-28529 # p 158
 N92-28531 # p 86
 N92-28532 # p 115
 N92-28534 # p 248
 N92-28536 # p 116
 N92-28539 # p 116
 N92-28541 # p 116
 N92-28543 # p 116
 N92-28544 # p 116
 N92-28546 # p 117
 N92-28548 # p 117
 N92-28552 # p 117
 N92-28579 # p 117
 N92-28581 # p 261
 N92-28634 # p 86
 N92-28635 # p 264
 N92-28643 # p 220
 N92-28648 # p 261
 N92-28649 # p 86
 N92-28650 # p 220
 N92-28651 # p 87
 N92-28652 # p 109
 N92-28653 # p 109
 N92-28654 # p 92
 N92-28655 # p 57
 N92-28657 # p 47
 N92-28658 # p 47
 N92-28659 # p 47
 N92-28660 # p 47
 N92-28661 # p 117
 N92-28687 # p 87
 N92-28689 # p 234
 N92-28692 # p 47
 N92-28694 # p 201
 N92-28709 # p 47
 N92-28712 # p 202
 N92-28788 # p 202
 N92-28789 # p 48
 N92-28844 # p 249
 N92-28850 # p 220
 N92-29118 # p 202
 N92-29159 # p 48
 N92-29201 # p 270
 N92-29204 # p 117
 N92-29206 # p 48
 N92-29213 # p 243
 N92-29218 # p 287
 N92-29219 # p 287
 N92-29300 # p 240
 N92-29304 # p 229
 N92-29306 # p 229
 N92-29326 # p 210
 N92-29499 # p 230
 N92-29603 # p 220
 N92-29604 # p 264
 N92-29605 # p 66
 N92-29615 # p 66
 N92-29616 # p 87
 N92-29629 # p 128
 N92-29647 # p 150
 N92-29648 # p 48
 N92-29649 # p 48
 N92-29650 # p 87
 N92-29680 # p 129
 N92-29683 # p 202
 N92-29688 # p 225
 N92-29703 # p 57
 N92-29707 # p 225
 N92-29713 # p 49
 N92-29741 # p 49
 N92-29870 # p 92
 N92-29874 # p 5
 N92-29877 # p 158
 N92-29878 # p 217
 N92-29879 # p 122
 N92-29884 # p 49
 N92-29889 # p 49
 N92-29926 # p 202
 N92-29972 # p 202
 N92-29977 # p 202
 N92-29997 # p 270
 N92-30023 # p 203
 N92-30123 # p 57
 N92-30129 # p 57

ACCESSION NUMBER INDEX

ACCESSION NUMBER INDEX

N92-71170

N92-30130 * #	p 57	N92-70151	p 206
N92-30133 * #	p 57	N92-70166	p 273
N92-30230 #	p 225	N92-70249	p 52
N92-30232 #	p 5	N92-70307	p 150
N92-30372 #	p 203	N92-70499	p 52
N92-30414 #	p 146	N92-70513	p 52
N92-30418 #	p 58	N92-70514	p 52
N92-30423 #	p 220	N92-70540	p 52
N92-30424 #	p 87	N92-70561	p 206
N92-30453 #	p 203	N92-70563	p 118
N92-30454 #	p 203	N92-70564	p 67
N92-30474 #	p 58	N92-70574	p 118
N92-30514 #	p 49	N92-70575	p 88
N92-30649 * #	p 203	N92-70576	p 53
N92-30651 * #	p 203	N92-70577	p 53
N92-30673 * #	p 203	N92-70590	p 53
N92-30674 #	p 204	N92-70591	p 88
N92-30675 #	p 5	N92-70627	p 122
N92-30676 #	p 50	N92-70983	p 118
N92-30713 #	p 50	N92-71104	p 221
N92-30769 #	p 118	N92-71169	p 278
N92-30941 * #	p 159	N92-71170	p 278
N92-30947 #	p 50		
N92-30952 #	p 260		
N92-30957 #	p 276		
N92-30996	p 287		
N92-31014 * #	p 243		
N92-31037 * #	p 240		
N92-31043 * #	p 210		
N92-31059 * #	p 210		
N92-31106 * #	p 241		
N92-31508 #	p 50		
N92-31514 #	p 50		
N92-31515 #	p 88		
N92-31813 #	p 58		
N92-31942 #	p 148		
N92-31943 #	p 58		
N92-32229 #	p 264		
N92-32398 #	p 285		
N92-32437 #	p 92		
N92-32447 #	p 93		
N92-32479	p 50		
N92-32673 #	p 51		
N92-32725 #	p 204		
N92-32730 #	p 51		
N92-32732 #	p 51		
N92-32734 #	p 118		
N92-32742 #	p 154		
N92-32750 #	p 109		
N92-32765 #	p 204		
N92-32767 #	p 204		
N92-32769 #	p 51		
N92-32770 #	p 204		
N92-32773 #	p 51		
N92-32776 #	p 204		
N92-32780	p 109		
N92-32782	p 51		
N92-32800 #	p 52		
N92-32830 #	p 66		
N92-32834 #	p 139		
N92-32835 #	p 205		
N92-32856	p 205		
N92-32895 #	p 150		
N92-32952 * #	p 270		
N92-32956 * #	p 270		
N92-32960 * #	p 270		
N92-32961 * #	p 271		
N92-32962 * #	p 271		
N92-33033 #	p 146		
N92-33036 #	p 146		
N92-33043 #	p 146		
N92-33044 #	p 146		
N92-33048 #	p 146		
N92-33053 #	p 146		
N92-33139 * #	p 221		
N92-33466 #	p 276		
N92-33538 #	p 214		
N92-33645 #	p 102		
N92-33686 #	p 276		
N92-33691 #	p 225		
N92-33694 #	p 288		
N92-33748 #	p 102		
N92-33750 #	p 88		
N92-33751 #	p 230		
N92-33908 #	p 249		
N92-33910 #	p 205		
N92-33916 #	p 205		
N92-33969	p 241		
N92-33996 #	p 205		
N92-34038	p 205		
N92-34152 #	p 211		
N92-34161 #	p 109		
N92-34164 #	p 109		
N92-34166 #	p 109		
N92-70048	p 241		
N92-70065 * #	p 139		

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